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# SCIENCE

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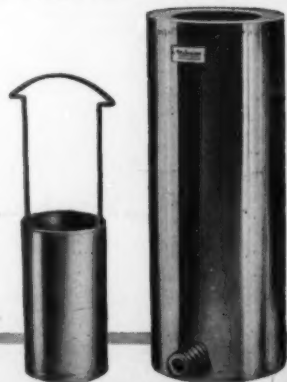


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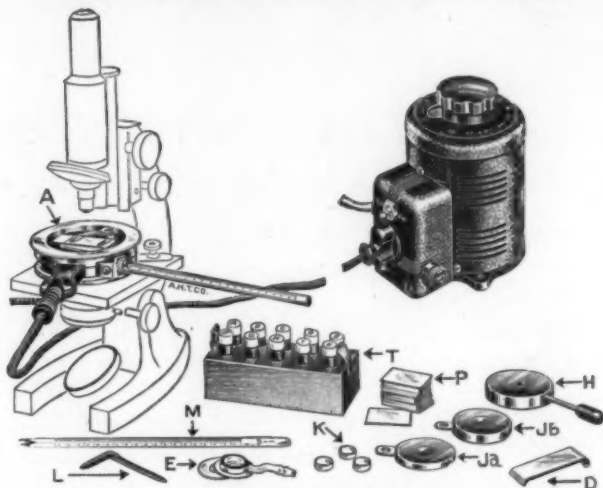
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## The Uncommon Metals

**R**ESearch is rapidly increasing in the field of unusual metals. There are several reasons. As the demands for extraordinary properties in metals increase with the ever-growing complexity of modern technology, there is a tendency to look beyond the dozen or so tried and true common metals into the properties and alloying possibilities of the lesser known. Also, the constant search for materials to replace or supplement scarce metals encourages more attention to this newer field. It is not a small field by any means. Over 80 per cent of the known 98 elements are metals, although some are unstable, or of doubtful value as metals at present. Even discounting these, and the common metals, the remainder constitute a vast storehouse of potential metal properties from which to draw as research makes them available.

Perhaps of greatest current interest is the activity in making metals of increasingly higher purity. Frequently this results in the discovery of unsuspected properties, particularly improved ductility, which permits a metal to be formed and used on its own merits instead of being a parasite coating or alloying addition to a stronger ductile base metal. The most dramatic example probably is titanium. On finding a workable method for obtaining sufficient purity to give high ductility, the way was opened to discovery of alloys having an unusual combination of high strength, comparatively low weight, and corrosion resistance. These, with the potential abundance of the element, make titanium the most promising recruit to our list of structural metals. Zirconium is going through a similar transition, whereby its excellent corrosion resistance can be utilized in fabricated equipment. Hafnium recently has been prepared in a massive ductile form, and its properties will be explored. Pure thorium shows remarkable softness when prepared in a solid compact form.

Chromium, which has been common only as a bright, hard plating, has always been considered to be extremely brittle and unworkable. By proper purification it can now be made hot-workable, and individual

grams show remarkably good cold ductility on working slowly. Likewise, vanadium shows promise of being a useful, fabricable metal. Hot-forming of pure beryllium is making this metal useful for purposes other than for alloying.

Practically unknown as a metal because of unworkable brittleness, bismuth now can be made into extremely soft ductile wire by proper processing. Such wire makes available to the physicist and electrical engineer some interesting properties—such as changing electrical resistance with change in magnetic field strength and a rather high thermoelectric power. Also dear to the heart of the physicist is the growing development in availability and purity of some of the semiconductors, such as germanium, selenium, tellurium, and silicon, which make available diode rectifiers and transistors, among many growing applications. Research among these metals and others near the borderline between metals and nonmetals promises to furnish the key that will open the way to realization of that very worth-while dream—the practical, direct conversion of heat to electrical energy.

The protection of metals against corrosion and high-temperature oxidation by cladding or coating is becoming more important with growth of various types of jet engines and other equipment exposed to extreme temperatures. Typical of one type of solution has been the formation of a silicon-base coating on molybdenum, which in experimental work permits the molybdenum to be heated in air at 1,500° to over 2,000° C.

Rare metals which soon may not be so rare that they cannot be considered for special uses include high-melting rhenium and low-melting gallium. Like so many of the unusual metals, and the group as a whole, their importance is not so much what they can do now but how little we know about them. Thus they constitute a fruitful field of metallurgical research, of which recent developments are only an indication of what lies ahead.

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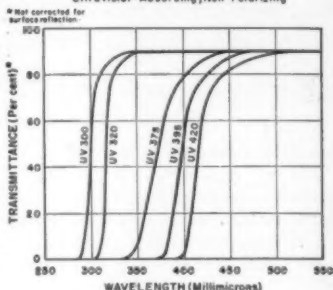
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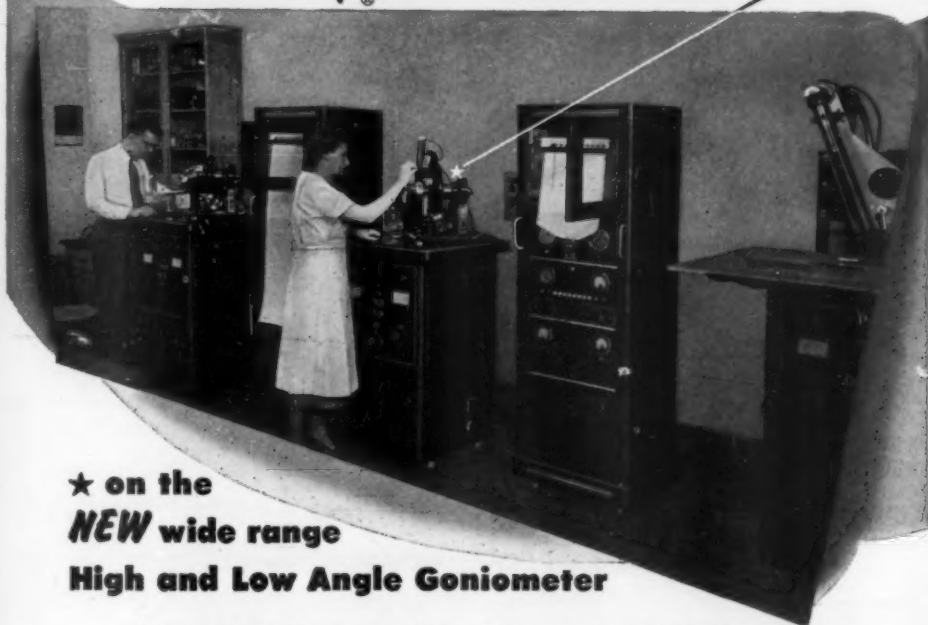
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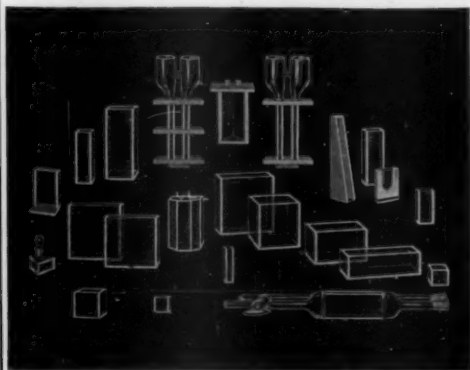
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# Learning and the Associative Pathways of the Human Cerebral Cortex<sup>1</sup>

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THE NATURE OF THE CHANGE that occurs in the brain when the individual learns is recognized today as one of the most significant problems of physiological psychology. Many theories, some with limited, but most with no, experimental foundation, have been proposed to account for this change. The critical physiological aftereffects of learning in mammals have been assumed in all such theories to occur in the cortex of the cerebral hemispheres, inasmuch as this part of the brain appears to be the most complex of all nerve structures and most affected by evolutionary development.

Accounts of numerous experiments have been published that purport to prove the very old idea that the cerebral cortex is the primary part of the nervous system concerned in learning (1). These experiments have involved surgical destruction of massive areas of the cortex and the observation that such ablations reduce the ability of animals to learn and to retain what has been learned. It is now recognized that these studies contained a weakness or fault in design, which precludes concrete conclusions from them concerning the physiology of learning functions. From results of the experiments it is impossible to tell whether the observed deficiencies in learning were the result of some integrative or learning disturbance itself or the outcome of motor and sensory defects that invariably appear when the visual, somesthetic, motor, and frontal areas of the brain are removed.

A new experimental approach has been made in recent years to this problem of the controlled study of learning and the cerebral cortex. This work has involved the study of the associative connections between different areas of the cortex. Through proper surgical operations and tests of learning it has been possible to investigate the role of the cortex in learning functions without producing in the animal subjects motor and sensory defects that complicate the observations of learning and retention.

Wing and the writer (2) performed a first study of this sort, whereby it was shown that generalization and second-order derivation of conditioned visual reactions in dogs with respect to auditory stimuli do not depend upon associative connections between the visual and auditory areas of the cortex. Lashley (3) has performed a somewhat more general experiment along the same lines, in which it was proved that ex-

tensive destruction of the associative neurones within and between areas of the rat's cortex has no observable effect upon learning and retention of the maze habit.

Through an opportunity afforded by a special project primarily oriented toward the neurosurgical control of epilepsy (4), it has been possible to extend, in a limited way, this controlled study of the role of the associative mechanism of the cortex in learning. An investigation was made of the effects of cutting most of the associative connections between the two cerebral cortices upon learning and transfer of learned responses from one side of the body to the other.

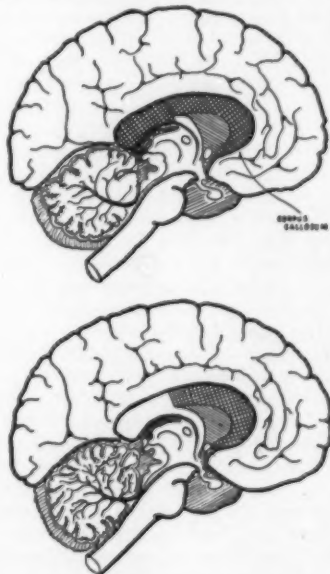


FIG. 1. The extent to which the fibers of the corpus callosum were cut in cases with complete section (top) and in the case with the least extensive lesion (bottom).

The neurosurgical operation involved consisted of cutting the pathways of the corpus callosum (Fig. 1) completely or in part. This body, the most extensive single band of fibers in the nervous system, contains all the interconnecting neurones between the two cerebral cortices, except for the very limited interconnections of a small tract called the anterior commissure.

In all, nine patients were selected for study. The

<sup>1</sup>The cooperation of William P. Van Wagenen and Andrew Akelaitis, whose help made these studies possible, has been greatly appreciated.

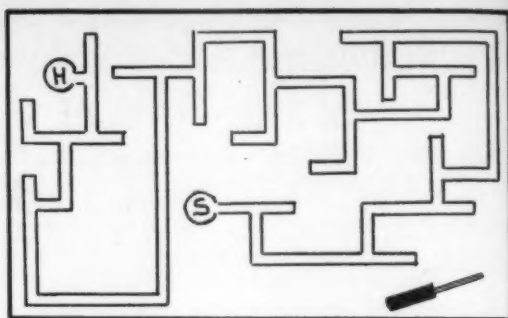
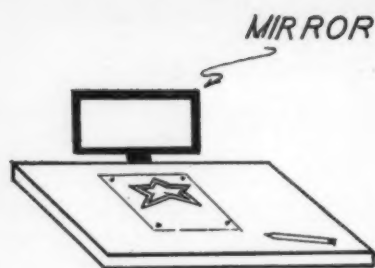


FIG. 2. Diagrams of the general nature of the mirror-drawing and the maze tasks. When in operation, a screen prevents a direct view of the star in the mirror-drawing situation. Time of performance is used as a measure of reaction. In the maze task the learning and transfer of learning are measured in terms of the number of trials required to trace the maze without error.

neurosurgeon's<sup>2</sup> notes, taken at the time of operation, described six of these patients as having complete section of the corpus callosum. In two patients all the commissure was cut except for the posterior tip. One patient had two thirds of the whole tract sectioned. The effect of the most extensive section is to isolate neurally to a more or less complete degree the cortex or covering of each of the two cerebral hemispheres.

Two types of learned performances were studied—mirror-drawing learning and nonvisual stylus maze learning (Fig. 2). Subjects learned these two tasks with the preferred hand and were thereafter tested to determine the degree to which this learning improved performance by the subordinate hand. For example, before operation subjects learned to trace the maze with the preferred hand while blindfolded, and the number of trials required to learn the habit without error was recorded. The subjects were then tested to determine how many trials were required to relearn to trace the same maze with the nonpreferred hand without error. After the neurosurgical operations, the same subjects were required to learn, using the preferred hand, a maze of a level of difficulty equal to the one learned before operation but with different blind alleys. Again they were tested for the number of trials to relearn the maze with the subordinate hand. The effect of the operation upon both learning of the maze, as well as upon the degree to which the learning by the preferred hand was transferred to the nonpreferred hand, could thus be determined. By alternating the order of mazes used before and after operation among different subjects, secondary effects of maze difficulty were controlled.

Because the learning of the mirror-drawing performance involves learning of new general perceptual relations, rather than specific responses of turning a particular direction, as in the maze habit, postoperative observations only were made with this task. In this case the time required by the subject to trace the star after a set number of trials was measured. The transfer score in this task was obtained by deter-

<sup>2</sup> William P. Van Wagenen.

mining the difference in time required to trace the star with the nonpreferred hand before and after training in tracing the star with the preferred hand.

Results showed that there was no discernible effect of the operations upon the mirror-drawing learning and mirror-drawing transfer. After operation, the mean performance time of the patients in this task, during both learning and transfer, was almost identical with that of a group of twenty-three control subjects.

The experiments on maze-learning and maze-transfer permitted comparison of preoperative and postoperative performance. In one set of observations the comparison was made between paired scores on the same five subjects before and after operation. Additional observations made possible comparison of results on seven epileptic subjects trained and tested preoperatively, and on nine subjects trained and tested postoperatively.

Table 1 summarizes the results of the first set of

TABLE 1  
DIFFERENCES IN PAIRED PREOPERATIVE AND POSTOPERATIVE LEARNING AND BILATERAL TRANSFER SCORES\*

Score	$M_1$ (Pre- opera- tive) $N = 5$	$M_2$ (Post- opera- tive) $N = 5$	$\sigma_1$ (Pre- opera- tive)	$\sigma_2$ (Post- opera- tive)	$t$
Learning trials	42.0	66.0	22.1	34.9	1.14
Transfer trials	7.4	26.4	4.8	12.7	2.59
Percentage transfer	82.2	52.2	10.2	33.8	1.54

\* Learning trials refer to the number of trials required to learn the maze with the preferred hand. Transfer trials mean the number required to relearn the maze without error with the nonpreferred hand. The percentage transfer score is the transfer-trial score weighted in terms of the learning-trial score.

observations. It will be noted that no significant differences in preoperative and postoperative scores were found for the paired scores. The difference in transfer trials is significant at the 10 per cent level.



In keeping with accepted statistical criteria, this difference is judged to represent no significance at all.

Similar comparisons made between the unpaired preoperative and postoperative scores based on nine operated cases and seven unoperated epileptic subjects give difference results. It should be noted that the five subjects on whom paired preoperative and postoperative scores were obtained were also common to the two groups in these observations. These data are given in Table 2. With these unpaired scores, significant

eliminate finally and consistently entrance in one or two blind alleys. Any postoperative increase in trial scores required to reach the criterion of learning in these subjects is best described as an inconsistent performance at or near the level of perfect running of the maze. All operated subjects were able to produce more or less accurately a pencil diagram of the pattern of correct paths of the maze upon completion of the experiment.

TABLE 2  
DIFFERENCES BETWEEN PREOPERATIVE AND POSTOPERATIVE LEARNING AND BILATERAL TRANSFER SCORES IN THE MAZE

Score	Mean pre-operative N = 7	Mean post-operative N = 9	$\sigma$ pre-operative	$\sigma$ post-operative	t
Learning trials	39.9	69.4	15.7	33.2	2.00
Transfer trials	7.0	25.3	4.1	11.6	3.74*
Percentage transfer	82.1	55.8	8.8	10.5	2.14†

\* Significant at the 1% level.

† Significant at 5% level.

differences are found for transfer trials. When these transfer trials are weighted relative to the number of trials required to learn (percentage transfer score), this weighted transfer score is also found to change significantly as a result of the operation.

Over-all results of the experiment seem to show that there may be some, but a limited and inconsistent, relation between the neural activities of the intercortical association pathways and the bilateral transfer of learned response that has been assumed to depend upon crossed connections between the two cerebral cortices. In all observations, except those concerned with the unpaired subjects in the maze study, the hypothesis that the differences found may arise from chance cannot be rejected. The functional dependence of bilateral transfer upon intercortical connections is possibly greater for the transfer of the maze habit than for mirror-drawing performance, inasmuch as some significant changes were noted for the maze transfer as a result of the cutting of the fibers of the corpus callosum. This difference in the effects of the operation upon transfer of the two performances may possibly be accounted for in part by the fact that the primary projection areas of the somesthetic system, the critical sensory mechanism for the maze performance, receive mainly nerve pathways from the contralateral side of the body, whereas the visual system, used primarily in the mirror-drawing performance, is equally represented in the two cerebral cortices.

The inconsistent data obtained on the maze habit may be clarified somewhat by observations taken on the subjects' performance after operation. None of the subjects had lost his memory for general orientation in the maze. The errors made by the operated subjects, among those few who showed an increase in errors postoperatively, consisted of an inability to

The present experiment represents one of the very few attempts that have been made to investigate by controlled experiment the factors of neurone conduction in the human brain in the development and maintenance of learned habits. The results may be interpreted in several ways, especially if one seeks to support unfounded speculative ideas about the neural trace in learning. For example, it may be proposed that, because of the multiplicity of sensory projection in different areas of the cortex, a variety of specific synaptic channels is provided in the brain, and that the corpus callosum is not essential for any of the crossed relations between the two sides of the body in learning and bilateral transfer of learned habits. Inasmuch as the experiment lacked rigid anatomical controls, it may also be asserted that some commissure fibers, left intact, could maintain the crossed functional relations between the two sides of the body.

If a priori considerations of the present experimental results are set aside, possibly significant conclusions may be derived from this study and from similar work already reported on infrahuman animals.

In one sense, the results are inconsistent in meaning. It has been found that section of the corpus callosum produces no discernible effect upon mirror-drawing transfer. In the case of two different sets of observations on the maze habit, however, the data are consistent with alternative hypotheses that some change and no change occurred in bilateral transfer as a result of the operation. Generally, the results would seem to be interpreted most correctly at this time, especially if the nature of the actual behavior of operated subjects in performing in the maze is considered, by the statement that extensive destruction of most of, if not all, the neural connections between the two cerebral cortices produces either no diminution—or at least an inconsistent diminution—of the ability of human subjects to transfer to the opposite side of the body motor habits learned by use of the preferred side.

If the above general statement of the present results is accepted, and if this finding is considered in relation to data from infrahuman animal studies, in which functions of the intracortical association pathways in learning have been investigated, certain ideas about the role of the cortex in learning may be suggested. Taken together, all these studies seem to point to two main conclusions: (1) there is no specific or generalized integrative neural mechanism of the cortex explicitly essential for learning and related func-

tions, which may be rendered seriously inoperative by injury to intracortical and intercortical association pathways; and (2) the neural integrative functions of the cortex in learning are therefore closely bound to the specific reactive and psychophysical mechanisms of the sensory and motor projection areas of the brain and are apparently inseparable from the processes underlying reactive and psychophysical aspects of behavior. These tentative conclusions suggest the necessity of new approaches to both the psychology of learning and the understanding of the physiology of the cortex. The concepts of generalized cortical mechanisms for learning, which act to link or prime, so to speak, synaptic neural chains for integrating different sensory-motor mechanisms in behavior, or which are defined in terms of equipotential masses of cortex functioning (5), are to be questioned particularly as a result of the cited experimental data.

Taken literally, the available experimental results would seem to stress especially the possibilities that the cortex, in contrast to traditional thinking, is primarily a reaction system and that, physiologically, learning consists of alterations within components of this reaction system, whether involving changes within the neurone or between neurones. If these possibilities are found to be true in fact, the problem of analyzing the nature of learning changes within the brain may turn out to be far more difficult than it is now conceived to be.

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## Technical Papers

### Photolabile Pigments in Invertebrates<sup>1</sup>

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The basic mechanism of vertebrate sensitivity to light is the presence of a photolabile pigment that bleaches upon exposure to light and regenerates in the dark. These pigments have long been associated with vertebrate photoreceptor systems and, except for very low concentrations in a few rodless retinas, have been uniformly demonstrated in all vertebrate retinas. The photic responses of invertebrates are closely analogous to those of vertebrates in both behavioral and kinetic aspects (1). It is to be expected that a similar photochemical receptor mechanism would be present in the invertebrates as well as in the vertebrates, particularly a light-absorbing pigment which initiates the primary step in the visual process, that of absorbing the incident radiant energy and initiating a physiological response in consequence.

Invertebrates, with few exceptions, have not yielded photolabile pigments. Bliss (2, 3) has demonstrated pigments which become photolabile after treatment with formalin, and St. George and Wald (4) demonstrated a photolabile pigment in the retina of the squid which bleaches under illumination, releasing the carotenoids that have been associated with the vertebrate visual cycle.

Several additional invertebrate species were examined to determine the occurrence of directly photo-

labile pigments. The two species reported here are *Nereis* and the starfish *Asterias rubrens*. These were chosen because of their representative position in their respective phyla and their taxonomic position relative to other phyla.

All operations were carried out at 10° C in very dim red light, from which the animals were completely shielded except for a few moments during processing. The animals were kept in complete darkness for 48 hr before extraction. The eye tissue was dissected away as free as possible from the surrounding structures. The dissected tissue was rinsed in sea water and drained on filter paper, and ground for 6-8 hr until a fine uniform paste resulted. The thick paste was then extracted with solvents that are effective for the extraction of visual purple. It was then centrifuged at high speed and stored at low temperature. The solutions were measured within a few hours of the completion of the extraction. At no time, until the measurements were made, did the temperature of the animals or solutions exceed 10° C.

The two species used yielded a pigment photosensitive to digitonin solutions and none to purified bile salt preparations. The photosensitivity was determined by measurement of the absorption spectrum of the solution before exposure to light, exposing the solution for short periods to the light of a 100-w lamp filtered through a 3-in. water layer, and again determining the absorption spectrum. The difference between the unexposed and exposed solutions represents the pigment that disappeared during illumination.

In Fig. 1 is plotted the absorption spectrum of the digitonin extract of the *Nereis* extract. The absorption decreases regularly from the blue to the red end of the spectrum. The difference between the unilluminated

<sup>1</sup> Supported in part by a grant from the Medical Sciences Division of the Office of Naval Research.

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and illuminated solution is also shown in Fig. 1. The maximum decrease in density is at approximately 505 m $\mu$ . The data for starfish are shown in Fig. 2. The unexposed extracts have an absorption maximum in the vicinity of 480 m $\mu$ . The effect of exposure to light is a slight increase in density in the vicinity of the absorption maximum and a marked decrease in the interval between 500 m $\mu$  and 600 m $\mu$ . The maximum difference between unexposed and exposed solution is at approximately 580 m $\mu$  and is shown in Fig. 2.

The difference between the maxima of the bleaching spectra of the two species suggests that the spectral sensitivity of the two animals would be quite different.

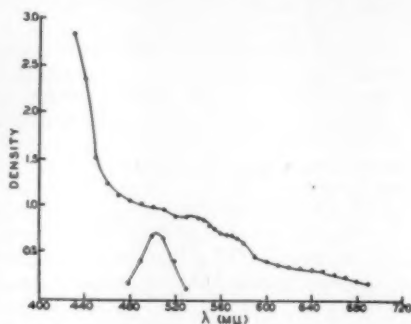


FIG. 1. Absorptive spectrum of digitonin extract of *Nereis*. Upper curve, absorption spectrum of unilluminated preparation; lower curve, difference spectrum between illuminated and unilluminated preparation. Density values for lower curve are multiplied by 10.

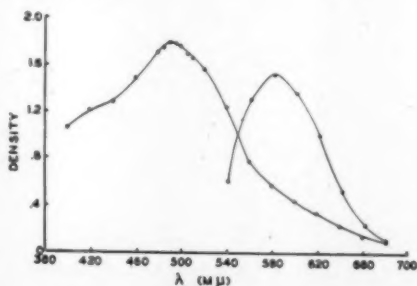


FIG. 2. Absorptive spectrum of digitonin extract of starfish preparation (*Asterias rubens*). Open circles are absorption spectrum of unilluminated extract. Filled circles are difference spectrum after illumination. Density values of difference spectrum are multiplied by 10.

The *Nereis* preparation falls within the familiar range of spectral sensitivity and pigment absorption known for vertebrates. The starfish preparation shows bleaching at somewhat longer wavelengths than is encountered in vertebrates, beyond even the maximum for cone pigment demonstrated by Wald (5) and Chase (6) for chick and frog, respectively. However, certain vertebrates seem to have spectral sensitivity maxima closer to the red end of the spectrum. Grundfest (7)

demonstrated that the sunfish has a double visual system, the low brightness portion having a maximum sensitivity at about 540 m $\mu$  and a high brightness maximum shifted 30 m $\mu$ –60 m $\mu$  toward the red. Subsequently, Wald demonstrated that fresh-water fish have a pigment system in which the maximum absorption of visual purple is in the vicinity of 540 m $\mu$  rather than at 500 m $\mu$ , and, although the cone substance was not demonstrated, it can be anticipated that it would be proportionately shifted still further toward the red end of the spectrum. However, the spectral sensitivity curves for various invertebrates seem to be distributed over a wider wavelength range than are those of vertebrates. Insects possess sensitivity far down into the blue and ultraviolet, whereas *Pholas dactylus* (8) shows a maximum sensitivity near 550 m $\mu$  and some suggestion of a second visibility peak below 450 m $\mu$ .

It was frequently observed that the starfish that were stored in a darkroom were always grouped at the end of the aquarium closest to the red darkroom light. This would suggest an appreciable sensitivity to the red illumination.

The choice of an extractive used to bring the photolabile pigment into solution from invertebrate tissue is of considerable importance. The purified bile salt extracts did not show photodecomposition under illumination for periods up to 2 hr. The starfish preparation alone showed some decrease in density after illumination for 24 hr by a 100-w water-filtered lamp. This sort of bleaching appears much too slow to account for the mediation of visual stimuli in the animal. It is possible, however, that the transfer of energy by the photochemical intermediary of the visual process is not necessarily dependent upon a decomposition of the absorbing pigment in all forms that are photosensitive. The pigments reported by Bliss, which required preliminary treatment, and preparations of several other invertebrates which showed no bleaching upon illumination (whelk, pecten) suggest that either the present methods are insufficient to extract the photolabile pigments, or that energy transfer can be accomplished without extensive photodecomposition. That this is a possibility is suggested by the delayed photodecomposition of visual purple at low temperature reported by Wald *et al.* (9), although in this latter case it has not yet been established whether the neural stimulation occurs at the time of the initial photochemical change in visual purple or during the subsequent thermal steps of the breakdown.

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# Ethylene Dibromide for Destroying Fruit Fly Infestations in Fruits and Vegetables

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Three species of fruit flies<sup>1</sup> are established in Hawaii and constitute a serious threat to mainland agriculture. Losses caused by these flies to Hawaiian agriculture consist both in direct damage to crops by larval feeding and in the restrictions imposed by quarantines on the free movement of crops to mainland markets.

In the event of even an incipient infestation on the mainland by one or more of these flies, quarantine restrictions would probably involve the greater losses, unless satisfactory commodity treatments for eliminating fly infestations were available for the large quantities of fresh fruit and vegetables that might be grown in the infested area.

Vapor-heat and methyl bromide treatments have been developed and used successfully in the export from Hawaii of papaya, pineapple, tomato, bell pepper, and zucchini. However, recurrent injury has been reported occasionally even where the treatment has been carefully controlled. The cause of such injury is not clear. It has been variously attributed to season, rainfall, location, soil, varietal differences, and cultural and agronomic practices. Many quarantined commodities, such as bananas, avocados, string beans, and cucumbers, would not tolerate either treatment.

In the course of screening various materials as fumigants on naked eggs and larvae of the oriental fruit fly, it was found that ethylene dibromide was the most toxic of 53 compounds tested.<sup>2</sup> The LD<sub>50</sub> concentrations at 70° F were 0.43 mg/l for eggs and 0.95 mg for third-instar larvae. Concentrations of methyl bromide required to give the same mortality were 24.5 and 18.5 mg/l.

In large-scale tests ethylene dibromide was used successfully as a fumigant to destroy the immature stages of the oriental fruit fly in papaya and guava and the melon fly in cucumbers and tomatoes. Complete mortality was obtained at dosages of ½ lb/1,000 cu ft for 2 hr at 70° F for the oriental fruit fly and at ¼ lb for the melon fly. In these studies 11,459 fruits with fruit fly infestations of 137,077 eggs and larvae were used. The liquid fumigant was volatilized by heating. Phytotoxicity tests with papaya, pineapple, avocado, Cavendish banana, bell pepper, zucchini, cucumber, and string beans showed no injury from the gas concentrations required to produce complete fruit fly mortality. A comparison of mortality curves shows that ethylene dibromide is approxi-

mately 17 times as effective as methyl bromide in destroying the immature stages of the oriental fruit fly in papaya.

Preliminary data indicate that ethylene dibromide shows the same order of toxicity to the Mediterranean fruit fly and the oriental fruit fly.

## Formation of a Competitive Antagonist of Vitamin B<sub>12</sub> by Oxidation

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In the course of an investigation of the effect of various chemical procedures on vitamin B<sub>12</sub> it was found that treatment of the vitamin in strong acid solution with hydrogen peroxide caused a decolorization of the solution. Tests of this solution showed that the reaction product exhibited a competitive antagonism to vitamin B<sub>12</sub>.

To 10 ml of a B<sub>12</sub> solution containing 100γ/ml was added 5 ml of concentrated HCl. A few drops of a 30% solution of hydrogen peroxide were added, with stirring at room temperature. The solution decolorized. It was allowed to stand for about an hour at room temperature and was then neutralized with NaOH. The activity of this solution was then assayed directly on *Lactobacillus leichmanii* 4797, using the method of Skeggs *et al.* (1).

The results, presented in Table 1, showed an in-

TABLE 1  
EFFECT OF A B<sub>12</sub> OXIDATION PRODUCT ON  
*Lactobacillus leichmanii*

Vitamin B <sub>12</sub> (γ/tube)	B <sub>12</sub> oxidation product (γ/tube)				
	0	5	10	25	50
0	0	0	0	0	0
0.001	210	175	140	25	0
0.005	270	200	220	137	0
0.05	300	310	282	230	0
0.5	286	295	275	240	0
5.0	298	310	305	280	25

hibitory effect of the substance on the microorganism, which could be counteracted by vitamin B<sub>12</sub>. Only at the highest level of inhibitor tested was there incomplete counteraction.

Figures representing the concentration of the B<sub>12</sub> reaction product are based on the original concentration of B<sub>12</sub> in the starting material. The figures for bacterial growth are direct readings on the Klett-Summerson colorimeter, which was set at zero with the organism control.

The solution was also tested on *Staph. aureus*, *S. typhosa*, and *Ps. aeruginosa*, three organisms that do not require preformed vitamin B<sub>12</sub> as a growth fac-

<sup>1</sup> The Mediterranean fruit fly, *Ceratitis capitata* (Wied.), the melon fly, *Dacus cucurbitae* Coq., and the oriental fruit fly, *Dacus dorsalis* Hendel.

<sup>2</sup> These screening tests were made by the author and D. L. Lindgren, University of California Citrus Experiment Station, Riverside, Calif.



tor. No inhibitory effect was observed in these systems.

The substance formed in the reaction described above would thus, on the basis of these tests, appear to have a specific antagonistic effect to vitamin B<sub>12</sub>, since it is counteracted by the vitamin and has no inhibitory effect where the vitamin is not an essential factor. The chemical structure is not known, although the fact that the solution was decolorized during the reaction would indicate that the cyanide-cobalt complex was attacked. That this complex could be broken up by permanganate oxidation was reported by Brink *et al.* (2). These authors, however, identified hydrocyanic acid as a reaction product and considered that they had converted vitamin B<sub>12</sub> into vitamin B<sub>12a</sub>. This is apparently not the case with the peroxide oxidation reported here, since free cyanide could not be found with the FeSO<sub>4</sub> test (3), and the reaction product has an antivitamin rather than a vitamin activity.

Further chemical and biological work on this material is in progress.

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## Functional Activity of the Sweat Glands in the Hairy Skin of the Dog

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The presence of the sweat glands in the dog not only in the foot pads but also over the body surface covered with hairs was described first by Gurlt in 1835 (1). His findings were confirmed by a number of investigators, and the literature was fully reviewed by Clausen (2). Nevertheless, we have found in several textbooks, monographs of physiology, and scientific encyclopedias a misleading description that in the dog sweat glands are found only in the foot pads. On the other hand, the lack of convincing evidence concerning the functional activity of the sweat glands in the hairy skin of the dog has hitherto led us to believe that this animal does not sweat over the general body surface.

The present paper is concerned with a demonstration of the sweating response in the hairy skin of the dog to some sudorific drugs and to local heating of the skin. For visualization of sweat we have used the iodine-starch method of Wada and Takagaki (3, 4), which proved to be suitable for this purpose. More than 30 dogs, mongrels and fox terriers, between the ages of 1 and 8 years were studied. Unanesthetized dogs were fastened to animal boards in either the supine or the prone position. The hairs of the regions to be tested were cut as short as possible, and the skin

was painted first with iodine-alcohol solution and then with a starch-castor oil mixture. The sweating was designated by the appearance of black spots at each orifice of the hair follicle (Fig. 1). In the skin with black hairs, it was somewhat difficult to find the sweat spots when there was little sweating. The front aspect of thorax and abdomen and ventral surface of the thigh were chosen as the most suitable regions for observation. In most of the animals no spontaneous sweating was observed on the hairy skin during the whole time of the experiment, even during violent struggling.

The first tests of the functional activity of the sweat glands were made with intradermal injections of pilocarpine, acetylcholine, or adrenalin. Pilocarpine hydrochloride (JSP), acetylcholine (Roche), and adrenalin hydrochloride (Sankyo Co.) solutions were diluted with 0.9% NaCl to appropriate concentrations. One tenth or 0.2 ml of each solution was injected intradermally. With concentrations of 1:10<sup>3</sup> to 1:10<sup>5</sup> each of these three drugs was effective in producing visible sweating around the site of injection. The sweating by adrenalin was not inhibited by atropine, unlike the sweating by pilocarpine or acetylcholine.

The excitability of the sweat glands was measured by determining the minimal effective concentration of adrenalin for sweating, as tried previously with human sweat glands (3); it was found to be of almost the same order as that of the sweat glands in the trunk and extremities of healthy young men and women. The minimal effective concentrations of adrenalin ranged from 1:10<sup>6</sup> to 1:10<sup>8</sup>, and those of acetylcholine from 1:10<sup>8</sup> to 1:10<sup>10</sup>.

Another evidence of the functional activity of the sweat glands in the hairy regions was the fact that the sweating response was easily elicited by a local application of heat. The upper or lower portion of the trunk was introduced into a wooden cabinet (50 × 80 × 60 cm) and subjected to the radiant heat supplied by four 100-w electric bulbs. The response was observed through glass windows in the top and in the side walls of the cabinet. When the temperature inside the heating cabinet, which was measured at some distance above the skin surface, reached 30°–35° C, sweating was found to have been induced. In some dogs it occurred at a temperature below 30° C. Usually sweating was localized in the heated regions, and areas of skin outside the cabinet showed for the most part no sweating, in spite of the fact that the heat was so excessive as to cause severe panting and a considerable rise in rectal temperature. In a few dogs, however, spontaneous sweating was observed to occur slightly in some restricted areas—e.g., around the umbilicus and in the median part of the hypogastric region—when the upper portion of the body was intensively heated.

The local sweating induced by application of radiant heat was through the peripheral mechanism, since it was produced even in skin areas in which the nerve supply had been removed by sympathectomy either



with or without excision of the ventral and dorsal roots, including their ganglia, of the corresponding spinal nerves. Such sweating could also readily be brought about in summer by direct exposure of the skin to excessive heat of the sun.

Further, such sweating could be demonstrated in skin strips excised from the body (Fig. 1), for a

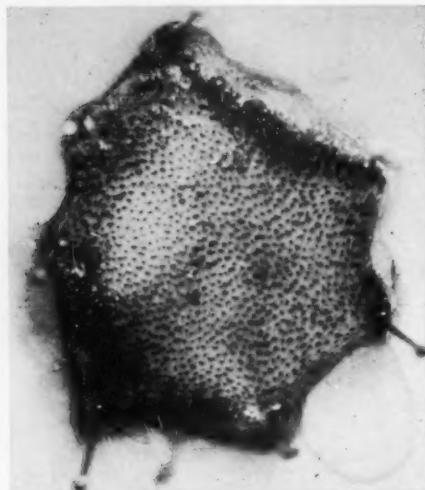


FIG. 1. Sweating response to radiant heat in dog's skin removed from front aspect of the thorax 5 min before heating. Sweating was rendered visible by black spots formed at the openings of hair follicles. Photographed after heating 10 min. ( $\times 2$ .)

certain length of time after removal from the body.

The fact that local sweating induced by radiant heat in the dog was not inhibited by atropine agrees with observation made by Randall (5) upon human skin. Yet the threshold skin temperature at which the sweating began to occur was  $38.4^{\circ}$  to  $38.7^{\circ}$  C in three of our dogs, in contrast to  $38.4^{\circ}$  to  $45.5^{\circ}$  C measured by Randall in cases of human skin.

Our findings suggest that the sweat glands in the hairy skin of the dog do not participate actively in the central thermoregulatory mechanism, but that they subserve chiefly the protection of the skin from an excessive rise of temperature.

Additional evidence of the secretory activity of the sweat glands in the dog's hairy skin under the influence of the sudorific drugs and radiant heat has been obtained by histological studies.

Recently, Coon and Rothman (6) discovered that in the human skin nicotine applied intradermally causes local sweating through the axon-reflex carried by the post-ganglionic sympathetic nerve fibers. Some of their experiments were repeated by one of us (W.) and our colleagues with similar results. In contrast, the hairy skin in most of the dogs showed no sweating response to a local application of nicotine in concentrations of  $1:10^4$ – $1:10^5$ , except in the restricted skin areas of some dogs, where spontaneous sweating,

probably reflex in mechanism, was produced. This suggests the possibility that functional integrity of the sudomotor fibers may be judged by the response of the sweat glands to nicotine.

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## The Quantitative Relationship between pH and the Activity of Weak Acids and Bases in Biological Experiments

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The influence of pH on the bactericidal and fungicidal effects of weak acids and bases has been recognized for some time, but the implications of this effect for metabolic studies have frequently escaped attention. Such studies on living cells and tissues often involve the use of weak acids and bases as substrates, inhibitors, or stimulants, and the pH at which they are applied may have an important bearing on their activity. Thus many acids of biochemical importance with pK values of about 4 or 5 are routinely used in solutions in which they are partially dissociated, and their activity can be shown to be influenced in a regular manner by changes in the pH of the medium.

Fig. 1, in which the concentrations of weak acid required to produce a standard response are plotted, shows the magnitude of this influence of pH. It is based on a study of graphs from 90 pH experiments

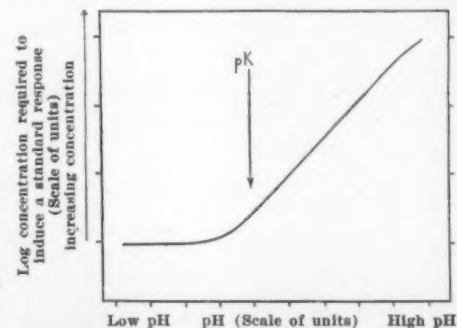


FIG. 1. The effect of pH on the concentrations of a weak acid that are required to give a standard response from the test organism. The corresponding graph for a weak base is obtained by reversing the pH scale. The curve is derived from a study of graphs from 90 pH experiments (1).

involving a wide range of acids, test organisms, and responses, and it thus represents a relationship between pH and activity that is of general occurrence (1). The construction of individual curves in which the concentrations of weak acid bringing about the selected response (e.g., a standard respiratory inhibition) are plotted against pH, and the derivation of the typical curve shown here, are described in detail elsewhere (1). It will be seen that the effect of a given pH change depends on the pK of the compound under investigation. Below pK, changes of pH are of little consequence, but as the pH is raised above pK the rising curve shows that the activity of the acid falls off by as much as three times for each pH unit. It should be noted that a decrease of ten times per pH unit would be expected if activity were confined entirely to undissociated molecules (1).

Since activity does vary so markedly with pH, a statement of a response to a weak acid or base should always be accompanied by a statement of the pH at which it was measured—e.g., 0.001 M iodoacetic acid gave 50% inhibition of respiration at pH 6.5, or p-amino benzoic acid was not effective below  $10^{-8}$  M at pH 7.0.

It is clear that rigid control of the pH of the medium is necessary in experiments with weak acids and bases. Neglect of this precaution may result in misleading conclusions. Thus it has been shown that the Lundsgaard differentiating effect of iodoacetic acid may in some cases result from a decrease in the pH of the medium in the fermentation vessel where respired  $\text{CO}_2$  is not absorbed (2). Again, Schroeder *et al.* (3) were able to disprove a claim that yeast poisoned with iodoacetic acid could be reactivated by the addition of certain amines by showing that the apparent reactivation was simply the result of the alkalinity of the reaction mixtures containing amines. Caution is required in interpreting the results of experiments designed to study the effect of the addition of a second acid to a tissue immersed in an unbuffered solution of an acid substance (e.g., the addition of malic acid to *Avena* coleoptile sections in 2,4-dichlorophenoxyacetic acid [4]).

The use of buffers for the control of pH is now a standard procedure, but, clearly, a buffer should be chosen which is not toxic to the test organism or tissue. This is particularly important in experiments designed to find the optimum pH level for the growth of an organism. If the acid used is toxic it will be most toxic under acid conditions, and this will influence the result obtained. Thus the optimum for the growth of *Absidia orchidis* was found (5) to be pH 4 when phosphate or citrate was used as a buffer; but with oxalate, which was slightly toxic, the optimum rose to pH 5, and with acetate it was pH 6. The more toxic the acid the more it will inhibit growth at a low pH and the higher the apparent optimum will become. Similar considerations would apply to other experiments in which the tissue under investigation is immersed in solutions of different pH.

The choice of pH in experiments has often been

made without thought of its effect on the activity of any weak acids or bases that may be present, and it is sometimes necessary to make comparisons between the experimental results of authors who have measured the activity of the same acid (inhibitor, metabolite, etc.) but at different pH levels (6). The accompanying graph provides a quantitative basis for such comparisons. Suppose, for instance, that one author reports that the respiration of tissue A is reduced by 50% by 0.001 M azide at pH 4.0, and that another author is unable to demonstrate similar inhibition of the respiration of tissue B with 0.005 M azide at pH 7.0. Reference to the graph shows that the change from pH 4.0 to 7.0 would reduce the activity of azide (pK 4.7) by 33 times. It follows that the work of the second author does not demonstrate the absence of an azide-sensitive respiration. If the two tissues were equally sensitive to azide then a concentration of 0.033 M would be required for 50% inhibition at pH 7.0.

One caution is necessary in the use of the graph. In a few clearly defined instances this relationship between pH and activity does not apply (7). Thus the effect of pH may be masked if a small quantity of active material is applied to a relatively large test object, as in pharmacological tests with laboratory animals, the *Avena* curvature test, or herbicide spraying experiments. Masking results because the pH of the applied solution affects the penetration of weak acids and bases only into those cells which are bathed by it. The degree of such masking, then, will be determined by the proportion of cells with which the external solution comes into contact; in bulky tissues this proportion may be very small, and the active substance will reach cells remote from the surface only after passage through other cells or intercellular fluids. The results from such tests are not therefore directly comparable to those obtained from experiments on thin slices of tissue or individual cells, in which all the cells whose responses are being measured are in direct contact with the test substance at the pH of the external medium.

It should be emphasized that in contrast to the behavior of weak acids (whose activity decreases with rising pH) and that of weak bases (whose activity increases with rising pH) the activity of a nonelectrolyte is not affected by pH changes. Hence the relative activities of weak acids, weak bases, and nonelectrolytes are determined by the pH at which the measurements are made, and the same is also true for two weak acids with different pK values. These considerations may be of prime importance in experiments designed to measure relative toxicity or the relative effectiveness of synthetic growth substances, vitamins, inhibitory analogs, etc. It has been shown (8) that the measure of activity most appropriate for studies of the relationship between activity and chemical structure or physical properties is the activity measured at a pH at which there is little or no dissociation. If the measurement is made at a pH at which the compounds are much dissociated, the pH

factor will obscure the difference in activity due to other factors. A pH two or more pH units below pK was recommended (8) for such measurements, but this may not always be practicable. Thus there are few organisms that could be used to measure the activity of a carboxylic acid of pK 4 at a pH of 2. In such a case it may be best to make the measurements at a convenient pH, say, pH 7, and then use the quantitative relationship between pH and activity shown in Fig. 1 to make a correction for the effects of the varying degrees of dissociation of the different compounds. It may be noted that an alternative form of correction has been used by some authors (9), who measured activity in terms of the concentration of undissociated molecules instead of the total concentration; this procedure is open to criticism because it is based on the unjustified (1) assumption that only undissociated molecules are active.

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### Loose Carbonate Accretions from Carlsbad Caverns, New Mexico

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The external shapes of loose carbonate accretions often indicate the type of core or "seed" around which they have grown. Three distinctive groups of loose accretions have been observed in Carlsbad Caverns. Undoubtedly more will be recognized as this study progresses; however, it is believed that these three represent the greater percentage of loose carbonate accretions to be found in the caverns. For simplicity, they will be referred to as the "spherical," "prismatic," and "irregular" groups, as shown in Fig. 1.

**Spherical accretions.** Small spherical accretions, or "cave pearls," usually have a very small calcareous fragment as a seed (II); this fragment is seldom more than 10% of the pearl's volume. Apparently, each accretion layer is nearly consistent in thickness over the entire surface of the previous layer. Pearls larger than a centimeter in diameter do not necessarily have a small seed.

**Prismatic accretions.** This group contains the forms

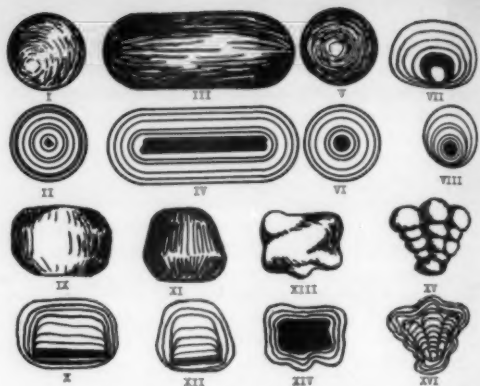


FIG. 1. I, Cave pearl,  $\times 1.5$ . II, Cross section. Angular spot in center represents sand grain; concentric circles, series of minute, irregular growth rings. III, Accretion with stalactite core,  $\times 1.5$ . IV, Transverse section. Heavy shaded center represents stalactite; lines represent series of minute, irregular growth increments. V, End view. VI, Cross section. Heavy shaded center represents stalactite; concentric circles represent series of minute, irregular growth increments. VII, Cross section of nonturning accretion with a stalactite fragment core (dark center),  $\times 1.5$ . VIII, Cross section of nonturning accretion with a cave pearl core (dark circle), and growth increments,  $\times .75$ . IX, Truncated prism accretion with a scale core,  $\times .75$ . X, Cross section showing scale core (dark area), and growth increments. XI, Truncated cone accretion with scale core,  $\times .75$ . XII, Cross section showing scale core (dark area), and growth increments. XIII, Irregular accretion with bedrock core,  $\times .75$ . XIV, Cross section showing bedrock core (dark area). XV, Irregular accretion with "popcorn" fragment core,  $\times .75$ . XVI, Cross section showing "popcorn" fragment as a triple series of vertical growth increments.

having fragments of stalactites or flat fragments as a core (III-XII). The stalactite core usually has the accretion layers concentric with its diameter (VI); however, at each end of the stalactite fragment the accretion growth tends to seal the ends and become convex in outline (IV). A scale or flake permits a faster rate of growth on its top surface than on the side or bottom (X, XII). After growth once stabilizes, the accretion formed around a scale or flat fragment will resemble a truncated cone or prism (IX-XII).

**Irregular accretions.** Irregularly shaped accretions usually have formed around fragments of bedrock or pieces of broken formations (XIII-XVI).

**Spheres or pearls.** These require constant turning while growing; if rotation ceases and growth continues, they will become elongated. Dripping water that causes rotation is most conducive to the forming of pearls; core or seed of such an accretion is usually a very small calcareous fragment.

**Prismatic.** Very elongated accretions usually form around a section of a broken stalactite. If this section is round in cross section, it rolls readily and forms concentric rings of growth (VI). If it cannot rotate, one side will be flat (VII, VIII).

Truncated prisms or cylinders represent growth on a flat fragment; many such fragments peel or spall from decomposing stalagmites. Growth on these fragments is primarily upward from the top surface; very little growth accumulates on the sides or bottom as

long as the scale cannot turn edgewise (center, X, XII).

*Irregular.* Accretions with very irregular form usually reflect the shape of core on which they have formed. Fluted pieces of bedrock, and fragments of formations comprise the cores of most irregular accretions.

## Associations of Rust and Virus Infections

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Attempts to transmit virus infections of plants by fungus and bacterial and nematode pathogens have generally been negative (1,2), though the work of Hedges (3) may be an exception. Extracts of fungi usually inactivate viruses (4), no virus infection of fungi is clearly established, and no plant virus has increased with certainty *in vitro*. Therefore the greater susceptibility to several viruses of rust-infected than normal tissues may be of interest.

Interaction of viruses of tobacco mosaic (TMV), tobacco ring spot, tobacco necrosis, alfalfa mosaic, cucumber mosaic, white clover mosaic, beet mosaic, beet curly top, squash mosaic, and potato latent mosaic, with the uredinial stages of rusts of bean, sunflower, snapdragon, or beet have been tested. Positive evidence of association of the first five viruses with bean rust (*Uromyces phaseoli* on *Phaseolus vulgaris*), of the first two with sunflower rust (*Puccinia helianthi* on *Helianthus annuus*), and of the second with snapdragon rust (*Puccinia antirrhini* on *Antirrhinum majus*) has been obtained.

Bean plants about 8 days old and in the primary leaf stage were inoculated with rust race 1 by applying a suspension of uredospores with a brush to the lower surface of one half of each leaf and incubating overnight in a moist chamber. About 3 days later the leaves were inoculated with virus by applying with a firm brush a suspension of virus-infected tissue to the carborundum-dusted upper surface of one leaf of the pair of leaves on each plant. After inoculation the virus extract and carborundum were washed from the leaf surface.

On nonrusted tissues, virus symptoms usually appeared as noninvasive, necrotic local lesions in 3 days when tobacco mosaic, tobacco ring spot, tobacco necrosis, or alfalfa mosaic were inoculated on bean, but no specific local symptoms resulted from inoculation of cucumber mosaic on bean or of TMV or ring spot on sunflower leaves.

When TMV was inoculated on beans with well-separated rust pustules, necrotic rings formed around some of the pustules (Fig. 1). With closely contiguous rust pustules TMV infection formed few necrotic lesions, and did not form necrotic rings around the individual pustules. The virus was invasive in such rusted tissue, through which it moved about 1 mm

per day, and formed a necrotic ring or margin around the entire rusted area. In virus-infected tissues, rust sporulation was reduced, and the tissue died sooner than in the absence of rust infection. The viruses of tobacco ring spot, tobacco necrosis, and alfalfa mosaic produced symptoms in rusted tissue somewhat like those of tobacco mosaic virus.

With cucumber mosaic virus on bean, circular necrotic lesions formed only in rusted tissues.

With TMV or tobacco ring spot virus on sunflower leaves no local lesions formed in the rusted or non-rusted areas, but assay of these tissues showed virus in both—more in the rusted than in the nonrusted areas.

Virus concentration in leaf tissues was measured by the local lesion method (5). In five trials the number of local lesions per square centimeter formed on *Nicotiana glutinosa* was 0, 0.02, and 0.08 for concentrations of 0.01, 0.1, and 1%, respectively, of tissues from TMV-inoculated nonrusted bean, and 0.3, 4.1, and 8.0 for 0.001, 0.01, and 0.1%, respectively, of tissues from TMV-inoculated rusted bean. For comparison the numbers were 2.2, 7.9, and 15 lesions for 0.0001, 0.001, and 0.01%, respectively, for tissues from tobacco systemically infected with TMV. When these data are plotted on log log scales, only the data for systemic TMV in tobacco gives the expected straight line, and it is therefore difficult to compare the virus concentration for these three types of tissues. If extrapolation of values is permitted, however, the writer believes, on the basis of the above

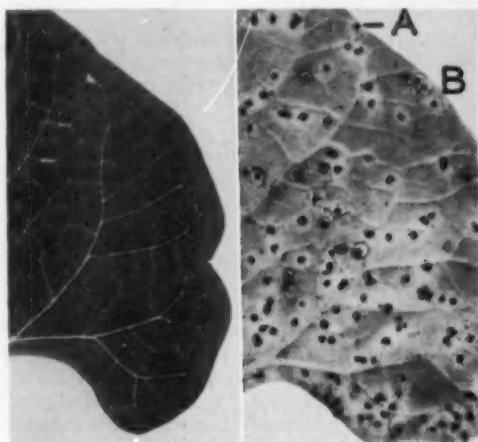


FIG. 1. Left, upper surface of pinto bean leaf showing ordinary local lesions caused by infection with tobacco mosaic virus. Right, lower surface of pinto bean leaf inoculated lightly with rust on May 12, and inoculated with tobacco mosaic virus on May 15; photographed May 31. Infection with tobacco mosaic virus appears as necrotic rings around some of the rust pustules: A, ordinary uredinial pustule without virus infection; B, a group of four uredinial pustules infected with virus. The virus infection apparently started in upper left pustule and has proceeded to lower right pustule, invading all contiguous pustules and forming progressively wider necrotic rings around the rust pustules. Similar symptoms were less distinctly seen on the upper leaf surface.



data, that the relative TMV concentration for TMV in nonrusted bean, rusted bean, and systemically infected tobacco was about 1:10,000:2,000,000, respectively. The value of 10,000 for the relative virus concentration in rusted in comparison with nonrusted tissue is not considered as finite or adequately determined. It has been shown to vary with age of leaf, age of virus infection, inoculum level of rust and virus, and bean variety.

If the virus concentration in the nonrusted tissue at about 15 days after inoculation is considered as 1, the virus concentration in other rusted tissues was as follows: 7 for tobacco mosaic in sunflower rust, 59 for alfalfa mosaic in bean rust, 440 for tobacco necrosis in bean rust, and 500 for tobacco ring spot in bean rust. With cucumber mosaic on bean, as assayed by local lesions on sugar beet, no such ratios can be indicated, for except for what is believed to be contamination in one test, none of this virus has been recovered from nonrusted tissue. Therefore the ratio of virus concentration in rusted tissue to that in nonrusted tissue was infinity. The bean variety Bountiful, of which nonrusted young and old leaves have been resistant to infection in the writer's tests, has been infected with TMV only when already infected with rust.

Although normal bean tissues become more resistant with age to TMV, tobacco necrosis, tobacco ring spot, and alfalfa mosaic, rusted tissues of similar age usually remain susceptible. Therefore it is likely that infinite differences in virus concentration between rusted and nonrusted tissues would result if beans of appropriate age were used.

With rust inoculation on sunflower plants already systemically infected with tobacco ring spot virus, no virus increase in association with the rust pustules was detected.

To measure the effect of rusted tissue on virus *in vitro*, fine suspensions of virus-free rusted and nonrusted bean tissues at different concentrations were added to TMV and tobacco necrosis virus at 0.01% tissue concentration. About 20 min after mixing, these suspensions were used as inocula on half-leaves of local lesion hosts (*N. glutinosa* for tobacco mosaic and *N. tabacum* for tobacco necrosis), and the virus suspension without supplement was used as inoculum on the opposite halves of the same leaves. At 0.003% concentration of rusted bean tissue, the number of TMV local lesions was 177% greater than for the control without rust extract, and this corresponds (from the straight line relating local lesions and virus concentration) to about an elevenfold increase in infective virus concentration. By the same token, a 0.01% concentration of bean rust tissue caused a five fold increase in infective tobacco necrosis virus. When these suspensions of virus and bean leaf tissues were allowed to stand overnight and then used as inocula, less stimulation of virus infectivity by rust tissues was detected.

Apparently significant smaller increases in infectivity were produced by nonrusted tissues at slightly

higher tissue concentration. However, at 1% concentration, tissues from nonrusted and rusted leaves caused great reduction in virus infectivity, and the rusted tissue caused greater reduction than the healthy.

Although the above results must be considered preliminary, it is concluded that rust-infected plant tissues may increase the invasiveness and infectivity of certain plant viruses. No certain exceptions are known, and the several cases of negative results could be explained on the basis of inadequate trials, inoculation methods, or assay methods for the viruses used.

The cause of these associations has not been determined. That the greater susceptibility of rusted than nonrusted tissues to virus infection is not due to the mechanical punctures made in the cell walls by the rust haustoria is indicated by the finding that infection of bean with *Erysiphe polygoni* or *Colletotrichum lindemuthianum*, which also puncture the cell walls, has not been found to favor virus infection. The finding (unpublished) of Louis Jacobson, of the Division of Plant Nutrition, that rust infection increases the number and amount of free amino acids in bean leaves may have an important bearing on the results reported in this paper.

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#### Spectrophotometric Determinations of Esterases

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Salicylic acid strongly absorbs ultraviolet light of a wavelength of 290 mμ–300 mμ, whereas acetylsalicylic acid (aspirin) does not absorb at all in this region. This was found to hold true for other fatty acid esters of salicylic acid as well (Fig. 1). This principle provides a convenient and sensitive method for the determinations of esterases in general.

Because of the free carboxy group, these compounds, including the longer chain fatty acid esters, are soluble in solutions of low acidity and can be used as substrates in continuous spectrophotometric measurements. The hydrolysis of as little as 0.01 μM of such an ester can be detected.

The measurements were carried out in the Beckman spectrophotometer. The reference cell contained buffer, substrate, and water to a final volume of 3 ml. The control cell contained buffer, substrate, water, and enzyme to a final volume of 3 ml. The other cells contained, in addition to the elements of the control cell, substances the influence of which upon the en-



zyme reaction were to be observed. The concentration of the substrate was identical in all cells, thus automatically cancelling the influence of spontaneous hydrolysis on the observed increase of absorption. Spontaneous hydrolysis was considerable in many cases.

Simultaneous comparison of the reaction rates in the different cells was completed by reading the extinction at 300 m $\mu$  every few minutes during a half-hour period or longer.

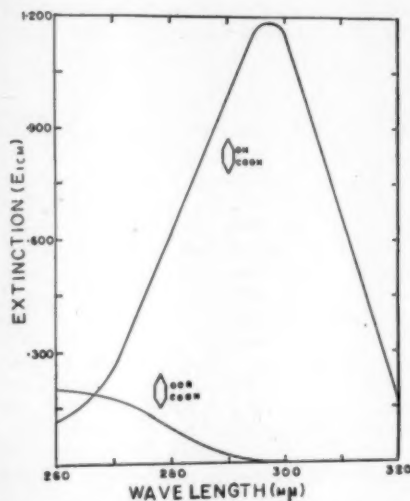


FIG. 1. Absorption spectra of  $3.3 \times 10^{-3} M$  solutions of salicylic acid and of salicylic acid esters at pH 8.0.

Acetylsalicylic acid was obtained commercially. The other esters were prepared from the acid anhydrides as starting material. They were recrystallized from alcohol until free from unchanged salicylic acid.

Solutions of the substrates were freshly made up before each experiment by heating the free acid with a few drops of alcohol and then mixing the melt with the buffer (0.075  $M$  veronal, pH 8.0) to which an amount of  $N$  NaOH, equivalent to the substrate, had been added. The following results were obtained with two different types of esterases.

**Choline esterase:** Table 1 shows the influence of a variety of activators and inhibitors on the esterolytic activity of normal human blood serum (specimen pooled from several individuals) with acetylsalicylic acid as the substrate. The concentration of the ester was  $1.66 \times 10^{-2} M$ , such high concentration being necessary to obtain maximum activity.

The observed activities appear to be due entirely to choline esterase ( $s$ -type) since there is practically complete inhibition by eserine in concentrations less than  $10^{-5} M$ , which is supposed to be characteristic for the choline esterases. Moreover, the hydrolysis of acetylsalicylic acid is inhibited by acetylcholine. The inactivation by compounds such as parathion and tri- $o$ -cresylphosphate and the activation by  $Ca^{++}$ ,

$Mn^{++}$ , and  $Mg^{++}$  also point toward this type of enzyme.

Acetylsalicylic acid has been used as a substrate for "true" choline esterase as well (1, 2). It seems to be very probable, therefore, that the activity of this enzyme can be determined with the present method.

TABLE 1

HYDROLYSIS OF ACETYSALICYLIC ACID ( $1.66 \times 10^{-2} M$ ) BY NORMAL HUMAN BLOOD SERUM AT pH 8.0

Influence of bivalent ions and of eserine on the reaction rate		
Additions to 0.025 ml serum	$\Delta E_{300 \text{ m}\mu}^{1 \text{ cm}} / 30 \text{ min}$	$\mu M$ Salicylic acid liberated/ml serum/hr
None (control)	0.040	2.7
$NaFl, 10^{-2} M$	.019	1.5
$CaCl_2, 10^{-2} M$	.280	18.6
$NaCl, 10^{-1} M$	.050	3.3
$CaCl_2, 10^{-1} M$	.320	21.3
$CaCl_2, 10^{-1} M$		
0.025 ml serum	.630	21.0
None (control)	.045	3.0
$MnSO_4, 10^{-2} M$	.372	24.8
$MgCl_2, 10^{-2} M$	.184	12.3
$CaCl_2, 10^{-1} M$ (control)	.240	16.0
$CaCl_2, 10^{-1} M$	.013	0.9
	(Total)	
Eserine, $10^{-5} M$	.005	0.3
	(First 6 min $\times 5$ )	
$CaCl_2, 10^{-1} M$	.049	3.3
	(Total)	
Eserine, $1.7 \times 10^{-5} M$	.005	0.3
	(First 6 min $\times 5$ )	
$CaCl_2, 10^{-1} M$ (control)	0.269	17.9
$CaCl_2, 10^{-1} M$		
Parathion, $10^{-4} M$	0.035	2.3
$CaCl_2, 10^{-1} M$		
Tri- $o$ -cresylphosphate, $10^{-4} M$	0.105	7.0

\* Poisons added to enzyme 20-30 min before the substrate.

† Furnished by C. H. Hine, University of California.

‡ Furnished by T. C. Daniels, University of California.

TABLE 2

HYDROLYSIS OF BUTYRYSALICYLIC ACID ( $1.66 \times 10^{-2} M$ ) BY AN AQUEOUS EXTRACT OF COMMERCIAL BOVINE LIPASE AT pH 8.0

Influence of $NaFl$ and of eserine on the reaction rate		
Additions to 1 ml 1% steapsin	$\Delta E_{300 \text{ m}\mu}^{1 \text{ cm}} / 30 \text{ min}$	$\mu M$ Salicylic acid liberated/ml extract/hr
None (control)	0.412	0.69
$NaFl, 10^{-2} M$	.414	.69
Eserine, $10^{-5} M$	0.412	0.69

**Pancreatic lipase:** As a source of the enzyme a commercial powdered bovine lipase preparation (steapsin) was used. A 1% aqueous extract was filtered over celite, resulting in a clear solution. By titrimetric

measurement it was shown that the extract hydrolyzed fats such as olive oil and tributyrin very rapidly. Monobutyrin was also attacked, although at a lower rate.

Using the spectrophotometric method described above, it was found that steapsin acting upon acetylsalicylic acid liberated only traces of salicylic acid. When steapsin was allowed to act upon longer chain fatty acid esters of salicylic acid the enzymic hydrolysis proceeded at significant rates.

The data in Table 2 were obtained with butyrylsalicylic acid as the substrate in a concentration of  $1.66 \times 10^{-2} M$ . It can be seen that in contrast to the blood serum enzyme, no inactivation by eserine is in evidence, and the enzyme seems to act in the absence of  $Ca^{++}$ .

We have the following evidence that the observed hydrolysis of the salicylic acid esters is effected by the same enzyme that hydrolyzes the glycerides.

1. When the steapsin extract acts on insoluble substrates (e.g., olive oil) bile salts are needed for activation. In such cases some additional activation can be observed by  $Ca^{++}$ , but even  $10^{-3} M$   $NaF$  does not completely inactivate the enzyme. When a soluble ester such as monobutyrin is used as the substrate, no bile salt is needed, and simultaneously the activity is not influenced by the presence of  $Ca^{++}$ . There is no inactivation by  $10^{-3} M$  eserine. The enzyme behaves the same when butyrylsalicylic acid is used as the substrate.

2. The ratios of the rates of hydrolysis of butyrylsalicylic acid by different steapsin preparations, including those that were partially inactivated by heat, were the same as values obtained when using monobutyrin as the substrate. Comparison with the activity toward olive oil could not be made, since in this case even in the presence of 2%  $Na$  taurocholate no proportionality between enzyme concentration and observed activity could be obtained.

3. The esters of the longer chain fatty acids are attacked preferentially. For instance, at the same concentration caproyl( $C_6$ )salicylic acid is hydrolyzed about twice as fast as the butyryl ester. Ethyl acetate is not attacked by the steapsin extract. This is similar to the observation of Nachlas and Seligman (3) who found that long chain fatty acid esters of  $\beta$ -naphthol are attacked by "lipase," whereas "unspecific esterase" preferentially attacks short chain esters.

4. The hydrolysis of butyrylsalicylic acid is inhibited competitively by mono- and by tributyrin, the latter being more effective than monobutyrin.

It should be mentioned that the rate of hydrolysis of caproylsalicylic acid, the highest in the homologous series of esters we have prepared thus far, is only of the order of 1/100 of the rate at which olive oil is attacked.

Results with longer chain esters will be reported when these compounds have been obtained in a pure form.

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## Resistance of a Protein-Montmorillonite Complex to Decomposition by Soil Microorganisms

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Soils high in clay are known to be much more retentive of soil organic matter than are soils low in clay mineral content. This fact has led to the generally accepted belief that there must be some sort of an interaction between the organic and inorganic colloids in soil, such as physical adsorption, complex formation, or chemical combination.

Considerable work has been done in recent years on the interaction of pure organic compounds with clay minerals, especially montmorillonite (1-4), the latter being most reactive because of its high base exchange and swelling capacities. The reaction involves the entry of the organic molecules between the platy sheets of clay, causing an expansion of the crystal lattice structure. Observations have been recorded showing the presence of mono-, di-, and trimolecular layers of organic molecules in the expanded crystal lattice (2). Gieseking (3) found that large organic nitrogenous compounds behave as do ammonium cations in being strongly adsorbed by montmorillonite, and could be exchanged by other cations of the same size but not by hydrogen. Hendricks (4) observed that large organic cations are held to the flat network surface by van der Waals forces between the neutral portions, as well as by electrostatic interaction of the charged parts. Ensminger and Gieseking (5) found that proteins, when complexed with montmorillonite, were in large measure resistant to hydrolysis by proteolytic enzymes. Allison et al. (6), in a study of inorganic soil colloid as a factor in retention of organic matter, reported that the addition of 10% bentonite to sand gave, in several instances, an approximately twofold increase in plant carbon held.

Evidence presented in the present preliminary report shows that a protein-montmorillonite complex is highly resistant to decomposition by soil microorganisms.

A diluted slurry of electrodyalized Wyoming bentonite having a pH of 2.15 and an equivalent diameter of  $<0.2 \mu$  was mixed with an aqueous solution of gelatin and shaken for several hours. After the pH was raised to 6.7 by the addition of solid calcium hydroxide, shaking was continued for a few more hours. The complex was removed by filtration, air-dried, and finally dried in an evacuated desiccator over phosphoric anhydride. The carbon content of the complex was found to be 1.54, which corresponds to 3.56% of gelatin.

Calcium bentonite was prepared by neutralizing the electrodyalized bentonite with calcium hydroxide, the pH of the product being 6.5.

The decomposition studies were conducted in 2-qt Mason jars. The additions were as follows: (a) 16.23 g protein-montmorillonite complex, containing 0.25 g carbon, plus 84 g quartz sand; (b) 0.58 g gelatin (0.25 g carbon), plus 15.65 g calcium bentonite and 84 g quartz sand; and (c) 0.58 g gelatin plus 100 g quartz sand. To each of these mixtures were added 10 ml nutrient medium, containing phosphorus, potash, and minor nutrients, and 2 ml soil infusion to supply an active soil population. Each of the first two treatments, where montmorillonite was present, received 8 ml water. Determinations of the evolved CO<sub>2</sub> were made daily during the first 4 days and on every third day thereafter. The data, presented graphically in Fig. 1, are typical of those being obtained.

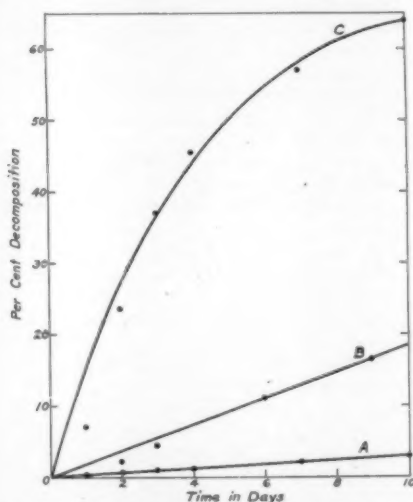


FIG. 1. Decomposition of gelatin by soil microorganisms: A, gelatin-bentonite complex; B, gelatin-bentonite mixture; C, gelatin alone.

The rate of decomposition of the gelatin in the gelatin-montmorillonite complex was considerably less than in the mixture of the two substances, but for a given material the rate was fairly constant during the period of the experiment. On the other hand, the gelatin in mixture with sand decomposed very rapidly at first, the rate decreasing markedly later. At the end of 10 days' incubation only 3.0% of the protein in the complex had decomposed, compared to 18.5% in mixture with bentonite, and 63.8% in the sand. These marked differences suggest that a considerable portion of the gelatin did enter into the crystal lattice where neither microorganisms nor their excreted enzymes could get to it. According to Ensminger and Giesekeing (7), the (001) spacing of the complex containing only 3.57% protein would be  $< 16 \text{ \AA}$ . Presumably the small amount of decomposition that takes place in the gelatin-complex preparation is limited to the protein attached to the external surfaces and edges of the montmorillonite. The low rate of decomposition

in the gelatin-bentonite-sand mixture also suggests that considerable interaction between the protein and clay mineral occurred even under these conditions. The significance of these findings in connection with soil organic matter maintenance is obvious.

These researches are being extended to include other organic compounds, as well as a study of factors pertinent to complex formation and decomposition.

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### Screening Effect of Vitamin C on the Inactivation of Leaf Phosphatase by Ultraviolet Light

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It is known that enzymes are inactivated by exposure to ultraviolet light. In an earlier publication (1) from this laboratory it was reported that vitamin C protects the enzymes—phosphatase, amylase, and pepsin—against inactivation by ultraviolet irradiation. But the mechanism of the reaction involved in the protection of the enzymes against inactivation by the vitamin has not been elucidated. The object of the present paper is to present results which throw light on the role of vitamin C in the reaction.

Ten ml of the phosphatase solution prepared from French-bean leaves purified by fractional precipitation with alcohol (2) was put into two quartz tubes. The solution was adjusted to pH 7.0. Ten ml of water and 10 ml of 10 mg of vitamin C solution in another set of two quartz tubes were used as screening materials and introduced between the light source and the

TABLE 1

Time (min)	Phosphatase activity in mg phosphorus after exposure to ultraviolet light filtered through water	Inactivation (%)	Phosphatase activity in mg phosphorus after exposure to ultraviolet light filtered through vitamin C solution	Inactivation (%)	Vitamin C (mg)
0	2.58	—	2.58	—	10
30	2.42	6.2	2.54	1.5	—
60	2.40	7.0	2.54	1.5	9.1
90	2.33	9.69	2.49	3.2	—
120	2.06	20.00	2.35	8.9	—
180	1.67	35.2	2.30	10.8	6.5

experimental tubes containing the enzyme solution. The vitamin C solution thus served as filter. The enzyme solutions were exposed to ultraviolet rays from a quartz mercury vapor lamp (Hanovia, 220 v, d-c) passed through vitamin C and water solutions, and the activity was determined at known intervals of time (Table 1).

The results show that vitamin C solution serves as a filter, absorbing the rays destructive to the enzyme, thereby protecting the enzyme from inactivation by ultraviolet light.

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## Intermittent Loud Noise and Mental Performance<sup>1</sup>

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In 1946 Berrien reviewed the literature dealing with the effects of intense sound upon human performance (1). He noted a dearth of conclusive evidence. Further studies have been reported (2-4), but the data are to some extent still contradictory and incomplete.

The concern of the present investigation was the effect of intermittent loud noise upon mental performance. There appears to be some agreement that intermittent sound can be expected to be more deleterious than continuous sound; furthermore, the special case of intermittent noise is one often encountered in practice, and it seemed to merit specific consideration. Also, for practical reasons the experiment was designed to motivate participants (as do industrial and military situations) toward the rapid, accurate completion of each task assigned; attempts to achieve productivity in a hit-or-miss fashion were severely penalized.

Fifty-two male and 17 female subjects were secured from among adult registrants in summer classes by announcements that emphasized the financially rewarding character of the experiment. (It is of possible interest that almost all the subjects were members of the band or glee club.)

The subjects reported to a large lecture auditorium at 8:45 p. m. The men were seated together in one section of the auditorium, the women in another. Persons occupying odd-numbered seats in odd-numbered rows, and persons occupying even-numbered seats in even-numbered rows, were then abstracted from the

<sup>1</sup> This investigation was carried on under Contract No. AF 33 (038)-786 (PR: 63275, E.O. No. 695-63) between the U. S. Air Force and The Pennsylvania State College. The author wishes to express his appreciation to Ralph Simon and F. T. Dietz, of the Department of Physics, for their extensive assistance in implementing the study; to J. F. Gillespie, H. A. Page, and H. B. Urban, of the Department of Psychology, for their aid in administering and proctoring the experimental tests; and to J. W. Dunlop, of the Department of Music Education, who was largely responsible for securing experimental subjects.

group and escorted to a similar room in an adjoining building. The latter subjects (26 male, 8 female) constituted the control group; those remaining in the auditorium (26 male, 9 female) constituted the experimental group.

In the central portion of each room, appropriate numbers of alternate seats were provided with packets of test equipment, and the subjects were disposed in these seats. To each group was then read the same set of directions: The subjects addressed stamped envelopes in which their "winnings would be mailed." They also signed "routine release forms" to protect the college against "irresponsible lawsuits." They were then led through the standard instructions for the Minnesota Clerical Test and for the Revised Minnesota Paper Form Board Test (Series AA), the tests to be utilized in the experiment.<sup>2</sup> The subjects consulted their own test booklets for this purpose but did not open them to the tests proper. Time limits of 7 min for the number-checking section of the clerical test, 7 min for the name-checking section of the same test, and 14 min for the form board test were announced and emphasized. A scoring system placing a heavy premium on accuracy (number of items correct minus twice the number incorrect or passed over) was imposed. And, finally, a first prize of \$15.00, two second prizes of \$10.00, three third prizes of \$5.00, four prizes of \$2.50, and general consolation prizes of \$1.00 were established.

Only after this identical indoctrination were the members of each group informed as to whether they were to work in silence or in sound. The control group was to "work in these ordinary surroundings, with no special noise being present." In the case of the experimental group it was announced that "The noise will come from the loudspeakers in this room. It will go off and on from time to time. It will be loud [brief sample of noise stimulus], but it is not dangerous. Try to do the best you can in spite of the noise."

The experiment then proceeded for both groups. The number-checking test was administered first, the name-checking test second, and the form board last. Between the end of one test and the beginning of the next only enough time was allowed to turn pages or to change booklets. The testing was thus completed in 30 min; the subjects then reassembled and returned their test packets. The tests were corrected, and the prizes awarded by mail, within a few days.

The two randomly selected groups were treated differentially in that the noise stimulus was administered to the experimental group only. The stimulus intensity was  $100 \pm 2$  db for each subject. The spectrum was substantially constant for all, being essentially flat between 100 cps and 3,000 cps, except for a rise of approximately 7 db in the region of 150 cps-300 cps

<sup>2</sup> The Minnesota Clerical Test consists of two subtests; one of these requires the subject to discriminate between pairs of identical numbers and pairs of slightly dissimilar numbers; the other requires a similar discrimination between pairs of names. The Minnesota Paper Form Board Test calls upon the subject to identify the result of assembling a given group of isolated plane figures. Both tests as used here were answered by marking directly upon the test booklets.

and a rise of approximately 4 db in the region of 2,500 cps; beginning at 3,000 cps, the sound level began a terminal drop of about 12 db per octave.<sup>3</sup> The noise: silence ratio for the experimental group was unity; that is, the total silent time was just equal to the total stimulus time. This ratio was maintained not only for the experimental period as a whole but for each successive minute during the period as well. Bursts of sound ranged in length between 10 sec and 50 sec and were administered at irregular and unpredictable intervals.

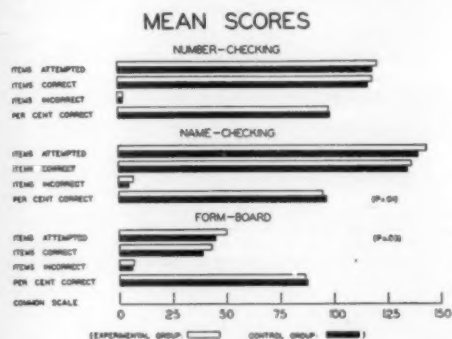


FIG. 1. Comparison of mean scores on all tests; for experimental group ( $n = 35$ ) and control group ( $n = 34$ ).

The principal data resulting from the experiment are summarized in Figs. 1 and 2. Fig. 1 compares the mean scores of the experimental group with those of the control group; it will be observed that each test was scored in the dimensions of (1) number of items attempted (including items passed over); (2) number of items correct; (3) number of items incorrect (or passed over); and (4) percentage of attempted items correct. Fig. 2 presents comparatively the standard deviations associated with each of the mean scores of Fig. 1.

The differences in performance revealed by Fig. 1 are quite consistent. In each test the experimental group attempted more items, got more items correct, and got more items incorrect; however, in the experimental group the percentage of accuracy was lower. Two of the differences achieved conventional levels of

## STANDARD DEVIATIONS

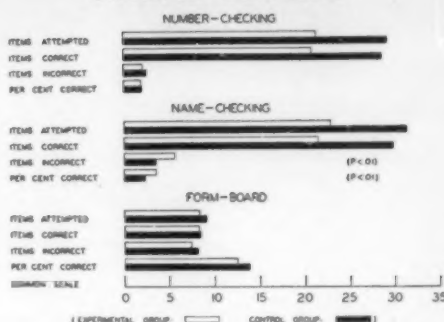


FIG. 2. Comparison of standard deviations associated with mean scores; for experimental group ( $n = 35$ ) and control group ( $n = 34$ ).

statistical significance, and the  $P$ -value for each of these differences is noted. One (form board, items attempted) was significant at the 0.03 level of confidence, another (name-checking, percentage correct) at the 0.01 level. Evidently the extraneous noise tended to encourage productivity but to discourage accuracy. The question remains as to whether these tendencies were of practical as well as statistical significance.

The variability differences, as portrayed in Fig. 2, were somewhat more substantial. With two exceptions, the experimental group showed in every case a standard deviation smaller than that of the control group, and the differences were sometimes considerable. Statistical analysis revealed, however, that it was only the two reversals (name-checking, items incorrect and percentage correct) that achieved statistical significance. The only reliable indication, then, is that the stimulus produced in one task an increment of variability in number of unacceptable responses and in over-all accuracy.

It has thus been found that the effect upon short-term mental performance of bursts of intense noise is to increase the quantity and decrease the quality of response, but that these effects are of such magnitude as to suggest that they are practically negligible.<sup>4</sup> It may be that the allegedly malignant effects of extraneous noise are to be found primarily in terms of depreciation in sustained performance, or of interference with functions other than adequate output.

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<sup>4</sup> Analysis of results for the male subjects alone, as a particularly homogeneous group, supported the same conclusions.

<sup>3</sup> The stimulus was produced by amplifying the thermal noise of a continuously conducting gas triode. The output from initial amplification was fed in parallel to a Bogen EX-35 and to a Bogen E-14 amplifier. The first amplifier drove in parallel two G-E 81201D speakers, directed from the two sides of the auditorium toward its center; the second amplifier drove a single Jensen A-12 PM speaker, mounted at the front of the auditorium. Sound level measurements were made with a Scott 410A hand meter, on the "Flat" setting, and are reported in db re  $2 \times 10^{-4}$  dynes per cm<sup>2</sup>. Sound spectra were obtained through the use of an Altec-Lansing 21B condenser microphone, a Hewlett-Packard 300A wave analyzer, and an Esterline-Angus AW recording millimeter.



# Comments and Communications

## Science Communications<sup>1</sup>

ANY organism, says Wiener (1), . . . is held together . . . by the possession of means for the acquisition, use, retention, and transmission of information. . . . A group of nonsocial animals, temporarily assembled, contains very little group information, even though its members may possess much information as individuals. Properly speaking, the community extends only so far as there extends an effectual transmission of information.

In some respects, the world of science today resembles a group of nonsocial animals with very little group information. According to Flynn (2), ". . . the acceleration of research and the increase in research publications are world-wide. . . . We are threatened with being choked with the flood of our own research production."

About 750,000 original papers appear annually, of which only about one third are abstracted (3), and the total volume of scientific literature increases by about 5% per year (4). There are thus physical, as well as intellectual, bases for the narrowing of comprehension which has accompanied the intense specialization among scientists in recent decades. According to the findings of the Royal Society Scientific Information Conference of 1948 (5),

. . . we must expect inferior science from those who cannot work at the great research centers, until mechanisms are developed to insure that every scientist, no matter where he may be, may have access to the record of science to the full extent to which it can contribute to his investigations.

Perry (6), chairman of the Division of Chemical Literature of the American Chemical Society, puts it in more immediately practical terms, pointing out that

. . . failure to make full use of recorded chemical knowledge may seriously impede a research program and make it more costly. For whenever helpful information and data recorded in the literature are overlooked, it is virtually certain that needless experimental work will be done in the laboratory. It is a rule with few exceptions that the cost of laboratory experimentation is many times greater than that involved in having a literature expert locate the record of previous experimentation.

Librarians for centuries, scientists much more recently, have been concerned about the canalization and flow of knowledge. At a recent conference on abstracting under the auspices of the Natural Sciences Division of Unesco, "Many present expressed the opinion that conditions have now become so chaotic that scientists will be compelled to aid in seeking some solution" (7). It is not the purpose of this paper to list the detailed techniques developed, or the suggestions

<sup>1</sup> Based on a paper delivered December 26, 1950, at Cleveland, Ohio, before Section Q of the American Association for the Advancement of Science.

advanced, but rather to propose for discussion an organizational device by which American scientists through the AAAS may greatly promote the advancement of science. Worthy at least of mention, however, are the growth of the abstracting services, and especially the achievement of international formal co-operation in physics abstracting (8); the establishing of the Division of Chemical Literature of the American Chemical Society; and the formation of the Science Office of the U. S. Department of State, to promote the international exchange of scientific information.

Although a large and increasing number of scientists are devoting their full time to problems and services of "science intelligence," there is no professional organization of such persons. Such a group is proposed by Miles (9), who lists 27 areas of endeavor in which an organization of scientific and technical communications specialists might be active. Whether or not such a group is formed, the suggestion of the Assistant Administrative Secretary of the AAAS should be considered: that an interdisciplinary AAAS Committee on Science Communications be charged with the fostering of improvements in "literature science" (10). Whatever the type of communications group, it might contribute greatly along the following lines:

- 1) By providing a forum, accessible to all subject areas of science, for the suggestion, discussion, and dissemination of communications techniques;
- 2) By aiding in the adoption of criteria for standardization and curricularization of the training of workers in science communications;
- 3) Not least important, by recognizing publicly the existence of communications work as a professional-level occupation of social and scientific value, comparable to that of bench research or teaching;
- 4) By facilitating, in the very nature of the organization, exploitation of interarea developments in science ("it is these boundary regions of science," says Wiener, "which offer the richest opportunities. . . . They are at the same time the most refractory to the accepted techniques of . . . the division of labor.");
- 5) By freeing the bench scientist for his specialized work, improving the form and content of communications, and facilitating the flow, promotion, and exploitation of ideas;
- 6) By counteracting to some extent, on the technical level, the current constriction of channels of communication among scientists, and between scientists and laymen.

Several, and perhaps all, of the subject-area sections of the AAAS may be expected to be interested in a communications group, judging by the experience of the similar Cooperative Committee on the Teaching of Science and Mathematics. Possible composition of the communications group is indicated by the backgrounds of those attending the recent National Research Council Conference on Primary Publication: There were representatives of government, industry,

journals, publishers, libraries, professional societies, and other organizations, including universities and research foundations (11, 12).

Industrial and governmental laboratories have had for some years, and at an increasing rate are establishing, science communications groups whose functions frequently embrace independent research and teaching, as well as service. No such units exist in academic and other nonprofit, nongovernmental institutions, so far as I am aware (13), although I have suggested such groups (14). Since, with the exception of the American Chemical Society, organizations of laboratory and clinical scientists do not recognize professionally the experts in communications in their fields, academic scientists are excusably hesitant to enter communications work lest it jeopardize their chances of advancement. The existence of a national communications group made up primarily of scientists might encourage literature science developments in academic staffs.

This proposal is fundamentally in the field of education and was presented accordingly before Section Q. The encouraging reception there is reminiscent of the fact that the Division of Literature Chemistry

grew out of the Division of Chemical Education of the American Chemical Society. The proposal is not restricted, however, to the advancement of educational technology; as conceived, it concerns the entire function of the AAAS—the advancement of science.

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## Book Reviews

*Marine Geology*. Ph. H. Kuenen. New York: Wiley; London: Chapman & Hall, 1950. 568 pp. \$7.50.

Professor Kuenen states that in preparing a work on marine geology he wished to "introduce university students of geology to an important branch of the science," to provide a guide to students who wish to explore the field, and to advance science by presenting achieved results and the problems remaining to be solved. He seems to have accomplished his objectives, but the problems remaining to be solved are far greater in number than the certainly achieved results.

To discuss in detail the many subjects covered in the book would involve pages not available for a review. Only some of the high lights can be noticed. In successive chapters there are considered: physical oceanography, the sea basins. Indonesian deep-sea depressions, sources and transportation of marine sediments, the formation of marine sediments, coral reefs, geomorphology of the sea floor, and eustatic changes of sea level. The author emphasizes that many problems of marine geology await solution, and, although he presents many of them with sympathetic consideration of the views of others, Kuenen has no hesitation in stating objections.

Discussion of the movements of sea water is rather complete, but parts are not easy reading. It is shown that the movements are generally quite complex because of various factors involved. Places of little or no movement of marine waters are designated "poorly

ventilated"—for example, the Black Sea and the flords of Norway—but there are other flords of similar character to which no reference is made. Consideration of poorly ventilated basins is timely, because they are rich in hydrogen sulfide, and though almost barren of life other than anaerobic bacteria they commonly contain much organic matter. The sediments are termed "euxinic." Overlying surface waters may be abundantly populated and, if the remains of the organisms living there settle on the bottom, perfect preservation is likely. Sediments of this origin are responsible for some black shales. The Baltic Sea is stated to have poorly ventilated bottom waters and to have hydrogen sulfide temporarily present, but nothing is said of the limans of the East Baltic, in some of which hydrogen sulfide is so abundantly formed that the odor may be carried for miles. Brief comment is made on the possibility that, under some climatic conditions different from those of the present, the deep bottoms of the sea might become poorly ventilated.

The author is of the opinion that the ocean basins have been permanent since the far distant past. Respectful consideration, however, is given to the views of other geologists who have suggested a lesser degree of permanence. Three oceans are distinguished: Pacific, Atlantic, and Indian. The Antarctic Sea, North Polar Basin, and Norwegian Sea are considered parts of these oceans. Other waters are marginal and inland seas, which may be deep or shallow. The

shallow seas are thought to have been important sites of deposition of ancient sediments. The problem of origin and the characteristics of the continental shelf are examined, and it is concluded that the origins, though far from being explained, are likely to have been different on different coasts. The terrace on the Atlantic coast of America seems to have been formed by fill, with some erosion, whereas on the Pacific coast faulting played an important part.

An entire chapter deals with the Indonesian deep-sea depressions, which have been studied for many years by Dutch geologists—among whom are Molengraaf, Brower, Kuening, and his associates—and also by others. Eighteen basins ranging from shallow to very deep have been differentiated. The deep basins are either V-shaped or U-shaped, and comparison is made with fossil sedimentation basins. This chapter includes some consideration of geosynclines, and Kuening very wisely does not add any new names to the many that have been coined for structural depressions. The question is raised as to whether any of the ancient sedimentation basins were abyssal in character, and it is noted that our knowledge of the depths of deposition of fossil sediments is limited to the evidence provided by diagnostic foraminifera, which indicate whether a sediment was deposited in 500–1,000 meters rather than 5,000–6,000 meters.

The sources of sediments and the agents delivering them to the sea are the atmosphere, which brings meteoritic particles, volcanic matter, and wind-blown sand; rivers; coastal erosion; glaciers and ice; skeletons and tests of organisms; and chemical precipitates. Some sediments are derived from erosion of the bottom. Transportation is accomplished by waves and currents, slumping, and turbidity currents. The last are considered important.

Kuening fully appreciates the importance and complexity of the marine profile of equilibrium in the deposition, erosion, and preservation of sediments. Unconformities, disconformities, and diastems are defined. The reviewer is not sure that he agrees with Kuening's understanding of the diastem, which, it is stated, may be recognized by bedding planes, sudden alterations in composition of sediments, and presence of broken or attached shells; but it is also very wisely noted that not one of these criteria is decisive. The reviewer knows of no criteria by which a diastem may be recognized, and of no way by which it may be distinguished from a disconformity. There is agreement with the view of Barrell that the sum of the time intervals recorded by the sediments in many sections is much shorter than the times represented by lost intervals. This would apply particularly to sediments deposited on bottoms that remained for a long time near the base level of deposition but not to bottoms that remained much below that level for a long time.

It is refreshing to note the importance ascribed to environments in the deposition of marine sediments, and to the complexity of environmental factors. Environments are littoral, neritic (0–200 m), bathyal

(200–1,000 m), and abyssal (greater than 1,000 m). It is also noted that distance from land is at least equal in importance to depth in determining the characteristics of the sediments. Other environments considered are the euxinic, delta, tidal flat, and estuarine. The last three are defined as transitional to land environments.

Sediments are described under names that are current in the literature. New names are not proposed. Destruction of stratification by mud-eating organisms is noted in several places, but the impression is left that its importance is underestimated. Rhythmic stratification and cyclothem receive brief consideration. Radioactivity of recent sediments and its absence in older sediments are explained, and attention is given to rates of deposition, particularly of those sediments deposited beneath the deep sea, the volume of which is shown to be large. The geoeconomy of several common elements is examined: for example, it is stated that silica is now accumulating on the continents, and that calcium carbonate is being, and for a long time has been, removed from circulation through deposition over the deep bottom of the sea, and that within 100,000,000–150,000,000 years it may become a scarce substance.

Coral reefs and coralline deposition are described with many illustrations drawn from Kuening's work in the East Indies. The work of algae in the construction of reefs is noted but does not receive the emphasis that it is currently believed to deserve. Theories of barrier reef and atoll formation are reviewed. The thorough treatment of coral reefs seems out of proportion to their importance, but it reflects the current emphasis on reefs in petroleum geology.

The chapter on the geomorphology of the sea floor is largely concerned with submarine valleys, which are classified as shelf channels and submarine canyons. The former are stated to be drowned river valleys, of which a well-known example is the Hudson Channel off New York City. The rather striking relation between some submarine canyons and rivers on the adjacent land is noted, but there are also many large rivers without canyons, and some large canyons are aligned with small rivers. The author supports Daly's view that the canyons were produced by turbidity currents during the Ice Age, but the reviewer doubts that turbidity currents are competent to erode canyons to the great depths that have been noted. The views of Davis, Sheppard, Johnson, and Bucher are considered and rejected. Here, too, the extended consideration seems out of proportion to importance.

Changes of sea level are dealt with in the final chapter. Possible recent eustatic changes are noted, but it is pointed out that the data supporting them are not completely trustworthy. Attention is given to glacial and postglacial eustatic changes of sea level resulting from extraction of water to make the glaciers and return of the water when the ice melted. It is noted that the data in general are little more than estimates. Stratigraphy is claimed to prove the occurrence of eustatic movements in the geologic past,

though the reviewer doubts that there have been many worldwide rises or falls of sea level. Kuenen concludes that the cause must be sought in changes in the cubic capacities of the basins, and he decides that deposition of sediments and diastrophism are inadequate to account for the movements that are known. He concludes that even the lesser eustatic movements "cannot be accounted for by processes operating in or at the surface of the crust," and that the principal cause must be found in internal factors acting below the crust.

The book is almost encyclopedic in character and illustrates the wide experience and thinking of the author, although it is difficult reading in places, partly because of deficiencies in the writing. Stratigraphy and sedimentary geology had their inception and early development through the work of students who had little knowledge of the sea, and many of them had never seen the sea. During the past three quarters of a century more and more scientists have seen the sea at work. To most students of earth science, for whom this has not been possible, *Marine Geology* will be a welcome volume. Many geologists will find sections to which they will wish to take exception, but to all the work should be of great service. The science of geology owes a debt of gratitude to Professor Kuenen for having brought the work to completion.

W. H. TWENHOFEL

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**Lehrbuch der Theoretischen Physik: Struktur der Materie**, Vol. II. Walter Weizel. West Berlin, Germany: Springer-Verlag, 1950. Pp. 772-1,540. DM 69.90 bound, DM 66 paper.

The art of *Handlehrbuch* writing is a typical German one, of which this is a very fine example. Whereas many books slide easily over certain subjects, depending on the author's preferences and opinions, the presentation in Professor Weizel's book marches forward with calm, heavy steps, leaving no stone unturned. The student will not be annoyed by statements such as "it can be easily shown that," or "after some simple calculations we obtain," since every derivation is described in all its painful detail. On the other hand, the book lacks the individuality characterizing the writings of authors of great contributions to the subject—a quality that may be of some value to a student struggling through many compactly printed pages. The text really helps, however, to fill the vacuum that existed in the physical literature in this field.

The presentation begins with a discussion of the elements of atomic theory, including a treatment of hydrogen and more complex atoms, by means of simple wave equations. The next chapter is devoted to the detailed development of modern quantum theory, and includes discussions of matrix method, statistical interpretation of wave mechanics, and the relativistic theory of electron spin. This is followed by chapters on molecules and valency forces, quantum

statistics, theory of gases, and the theory of solids. In every instance the subject is discussed in great detail, providing a complete picture of our present knowledge.

In contrast to the rest of the book the last chapter, devoted to the problems of elementary particles and nuclear physics, is extremely sketchy and incomplete. For example, it contains lengthy discussions of the mathematical formalism of the meson theory of nuclear forces and the structure of the deuteron, but completely omits such important topics as Fermi's theory of  $\beta$ -decay. The treatment of nuclear reactions occupies a scant four pages, and nuclear fission is mentioned only by name.

GEORGE GAMOW

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## Scientific Book Register

**Our Age of Unreason: A Study of the Irrational Forces in Social Life.** Rev. ed. Franz Alexander. Philadelphia: Lippincott, 1951. 338 pp. \$4.50.

**Powell of the Colorado.** William Culp Darrah. Princeton, N. J.: Princeton Univ. Press, 1951. 426 pp. \$6.00.

**Alkali Soils: Their Formation, Properties and Reclamation.** W. P. Kelley. New York: Reinhold, 1951. 176 pp. \$5.00.

**Radiochemical Studies: The Fission Products**, Books 1, 2, and 3. Charles D. Coryell and Nathan Sugarman, Eds. New York-London: McGraw-Hill, 1951. 2,086 pp. \$18.50 the set.

**Die Sonnenkorona: Beobachtungen der Korona 1939-1949**, Vol. I. M. Waldmeier. Basel: Verlag Birkhäuser, 1951. 270 pp. Sw. fr. 24.60; cloth, Sw. fr. 28.60.

**Thermodynamics of Fluid Flow.** Newman A. Hall. New York: Prentice-Hall, 1951. 278 pp. \$5.50.

**Communication: The Social Matrix of Psychiatry.** Jürgen Ruesch and Gregory Bateson. New York: Norton, 1951. 314 pp. \$4.50.

**Symposium on Steroids in Experimental and Clinical Practice.** Abraham White, Ed. Philadelphia: Blakiston, 1951. 415 pp., \$7.50.

**An Introduction to Modern Psychology.** O. L. Zangwill. New York: Philosophical Library, 1950. 227 pp. \$3.75.

**Medical Treatment: Principles and Their Application.** Geoffrey Evans, Ed. London: Butterworth; St. Louis: Mosby, 1951. 1,398 pp. and 66 pp. index. \$20.00.

**A Selected Bibliography of the Insects of the World Associated with Sugar Cane, Their Predators and Parasites.** J. S. Wade. Honolulu: International Society of Sugar Cane Technologists, 1951. 113 pp. Free to libraries.

**Geometrische Kristallographie und Kristalloptik und deren Arbeitsmethoden: Eine Einführung.** Rev. 2nd ed. Franz Raaz and Hermann Tertsch. Vienna: Springer-Verlag, 1951. 215 pp. \$4.50.

**Growth and Development of Children.** Ernest H. Watson and George H. Lowrey. Chicago: Year Book Pub., 1951. 260 pp. \$5.75.

**Instrumental Methods of Analysis.** 2nd ed. Hobart H. Willard, Lynne L. Merritt, and John A. Dean. New York: Van Nostrand, 1951. 344 pp. \$5.50.

**Climate in Everyday Life.** C. E. P. Brooks. New York: Philosophical Library, 1951. 314 pp. \$4.75.



## News and Notes

### Seventh Session of the South Pacific Commission

THE seventh session of the South Pacific Commission was held at Noumea April 28-May 7. Delegations from the member-governments of Australia, France, the Netherlands, New Zealand, the United Kingdom, and the United States attended. The session was under the chairmanship of Australia. Consideration by the commission of its work program for 1951 was an important item on the agenda.

In the field of social development, the commission authorized publication of a report on the vocational training of island peoples, prepared by R. A. Derrick, director of technical training, Government of Fiji. The commission also decided that a specialist be engaged to investigate the possible costs and other planning necessary should a decision be made by the member-governments to encourage the development of a centralized training institution or institutions for island peoples.

Two projects in applied anthropology were approved. One provides for promotion of studies of depopulation and overpopulation problems in various areas of the South Pacific. The second will comprise investigations of means for assisting island peoples to play a more important part in commerce and industry in the area.

Plant and animal quarantine in the South Pacific, and fisheries, were the main subjects discussed in the field of economic development. The commission declared the report of the Plant and Animal Quarantine Conference held at Suva in April to be a highly valuable contribution to the protection of the territories of the South Pacific against pests, diseases, and weeds. A sum of £ Stg. 3,000 was made available to enable effect to be given to recommendations of the report. These include the appointment of a research officer who will develop an information service concerning pests, diseases, and weeds of the region. Plant quarantine and animal advisory committees are to be set up, to serve as technical committees to advise the commission in dealing with plant and animal quarantine. Investigation of fisheries resources of the South Pacific forms one of the most important of the economic projects.

In the field of health, the commission made available a grant of up to £ Stg. 800 to the Medical Research Institute of French Oceania to investigate filariasis in Tahiti. The commission is sponsoring a filariasis conference of world experts to meet in Papeete this month, and it has also authorized the engagement of a specialist in leprosy. His services will be available in an advisory capacity to territories on request.

A progress report was approved at this session on action taken on the recommendations concerning the welfare of island peoples contained in the resolutions of the first South Pacific Conference held in Fiji in

April 1950. At the invitation of the French authorities, the second South Pacific Conference will be held in Noumea early in 1953.

Tribute was paid to the work of the retiring secretary-general, W. D. Forsyth, who returned to Australia in June to resume duty with the Department of External Affairs, from which he was given extended leave in 1948 to become the first secretary-general. Brian Freeston, present Governor of Fiji and high commissioner for the Western Pacific, has accepted the post of secretary-general and will assume his duties in November. Sir Brian has been United Kingdom senior commissioner since the inception of the commission.

### Scientists in the News

Among the twenty members of the Polytechnic Institute of Brooklyn who have been promoted to higher professorial rank are Marion Balicki, of the Department of Mechanical Engineering, Frank C. Collins and Frederick Eirich, of the Department of Chemistry, and Aaron D. Fialkow, Department of Mathematics.

William R. Bond has been appointed director of clinical research for the A. H. Robins Co., Richmond, Va. Dr. Bond is a special lecturer in physiology at the Medical College of Virginia and, from 1929 to 1934, was professor of physiology and associate professor of pharmacology at the same institution. He was engaged in medical research for the Schering Corp. from 1938 to 1946. More recently he has served as medical director for Charles C. Haskell & Co.

Walter M. Boothby has joined the Lovelace Foundation in Albuquerque, N. M. For the past eight months he has been adviser for research at the Air Force medical school. At the Lovelace Foundation he will organize an aviation physiology laboratory similar to the one he has developed at the Air Force school. It will work in cooperation with the Physiology Department at the University of New Mexico.

E. G. Bowen, chief of the Radiophysics Division of Australia's national research organization, has been voted the Thomas L. Thurlow Award for 1950 by the Institute of Navigation. The award is given each year for an outstanding contribution to the science of navigation. Dr. Bowen is cited for his recent work on radio aids to all-weather air navigation and traffic control at the Commonwealth Scientific and Industrial Research Organisation in Sidney.

William R. Chedsey, professor of mining engineering at the University of Illinois and former Colorado School of Mines professor, is one of the members of the Commission on Engineering Education, organized by the American Society for Engineering Education and the Unitarian Service Committee at the request of SCAP, to work in Japan.



**Robert D. Coghill**, director of research at Abbott Laboratories, has been appointed to the Selective Service Advisory Committee on Specialized Personnel. Dr. Coghill will serve on a special committee for the agricultural and biological sciences.

**Philip Davidson**, dean of the Senior College and Graduate School and provost of the Undergraduate Colleges at Vanderbilt University, has been named president of the University of Louisville. Dean Davidson has been an active participant in the affairs of the Oak Ridge Institute through membership on its Council.

**Benjamin D. Deacon** has recently been added to the staff of the Texas Engineering Experiment Station. He has been assigned to the Cottonseed Products Research Laboratory in the capacity of assistant research chemist and will work on research projects of the Cotton Research Committee of Texas and the station. Dr. Deacon has been with Eastman Kodak Company, Rochester, in its Synthetic Organic Research Department.

**Charles de Bretteville** has been elected president of the Spreckels Sugar Company succeeding **Carl J. Moroney**, who became board chairman. Mr. Moroney, active in the California cane- and beet-sugar industry for many years, has been president of Spreckels Sugar since 1946. Mr. de Bretteville joined the company in 1935 and has been a director since 1947. He is also president of Spreckels Companies, organized in 1948, and the Pampanga Sugar Mills, and is a director of the Bishop Oil Company and the Calaveras Cement Company.

**M. J. Dewar**, of Courtaulds Research Laboratories, has been appointed to the chair of chemistry at Queen Mary College, London University.

**John F. Dillon**, of the Air Force School of Aviation Medicine, has been placed on detached duty with the M. D. Anderson Hospital in Houston, where he will be engaged in research for the Air Force.

Eleven veteran Ohio State University staff members are retiring from active duty this summer. Among them are **Verne A. Dodd**, professor in the department of surgery; **Fred Fletcher**, clinical professor in the department of obstetrics and gynecology; **John F. Lyman**, agricultural biochemistry; **Hugh G. Beatty**, professor of otolaryngology and department chairman; **Perry P. Denuene**, sociology; and **Minnie Price**, School of Home Economics.

The Board of Scientific Directors of the Rockefeller Institute for Medical Research has announced the promotion of **Vincent P. Dole, Jr.**, and **Philip D. McMaster** from associate member to member. **Sam Granick** has been promoted from associate to associate member, and **William J. Eisenmenger**, **R. Barclay McGhee**, **George E. Palade**, **Gertrude E. Perlmann**, and **Elliott N. Shaw** have been promoted from assistant to associate. Eight new assistants have been appointed. **Carl**

**TenBroeck** has been made a member emeritus of the institute.

**Harry L. Erlicher**, vice president of General Electric Company, has been named special assistant to Under Secretary of the Army **Archibald S. Alexander**. Mr. Erlicher will be in charge of Army procurement and production expediting.

**Charles L. Forberg**, of Minneapolis, has been appointed assistant professor, and **Albert Szabo** has been appointed instructor, at the Institute of Design of Illinois Institute of Technology.

**Michael Klein**, who has held a post-doctorate fellowship at the National Cancer Institute for the past two years, has joined the staff of the Cancer Research Laboratory of the University of Florida as research assistant professor.

**Serge A. Korff**, professor of physics at NYU, has just returned from South America. He was one of the U. S. delegates at the fifth South American Congress of Chemistry, where he delivered an invited paper on Geiger counters. He also gave a series of lectures at the University of Chile, where he was honored by being elected an honorary member of the faculty.

**Robert E. Lee** has been named the recipient of the Borden Undergraduate Research Award for 1951. He received the award for original work on new analgesic drugs, for the demonstration that cortisone is not a centrally acting analgesic drug, and for a detailed study of the reaction of schizophrenic patients to the Thorn diagnostic test.

**Robert Livingston Schuyler**, Gouverneur Morris professor of history at Columbia and senior member of the Faculty of Political Science, retired July 1 after 45 years of teaching. He is currently president of the American Historical Association.

The 1951 Ciba Award, of the Association for the Study of Internal Secretions, given in recognition of meritorious accomplishments of an investigator not more than 35 years of age in the field of clinical or pre-clinical endocrinology, has been awarded to **Albert Segaloff**, staff member and director of endocrine research of the Alton Ochsner Medical Foundation. The Schering Fellowship in Endocrinology was awarded to **John D. Stockle** to permit him to study the factors controlling the peripheral use of thyroid hormone and related problems under the direction of **J. H. Means** and **John B. Stanbury** at the Massachusetts General Hospital.

The Institute of International Education has named **Gordon R. Silber** director of its European office in Paris. Dr. Silber is chairman of the modern language department at Union College. The institute, central private agency in the field of educational exchange of persons in the United States, operates programs with 66 countries. Dr. Silber will act as a liaison with universities, selection committees, foreign govern-

ments, and Unesco in all the European countries. The office also provides counseling services to Americans abroad and to French students interested in studying in the United States.

**Fred W. Stewart**, pathologist for the Memorial Hospital Center for Cancer and Allied Diseases, New York, was the recipient of the 1951 annual Bertner Foundation Award and delivered the Bertner Lecture at the University of Texas M. D. Anderson Hospital's fifth annual Symposium on Fundamental Cancer Research in Houston. Established in 1950, the Bertner Award and Lectureship will be given each year to an individual selected for his outstanding contributions to the field of cancer research. Dr. Stewart is also professor of pathology at Cornell. He is chief diagnostic pathologist for the Division of Laboratories and Research, New York State Department of Health, and consulting pathologist to numerous hospitals in New York and environs.

**William H. Sullivan**, scientific director of the Radiological Defense Laboratory at Hunters Point shipyard, has been appointed chief research scientist at the Oak Ridge National Laboratory.

**Thomas Scott Sutton**, assistant dean of the College of Agriculture at Ohio State and chairman of the Department of Agricultural Biochemistry, has been appointed chairman of the Department of Animal Husbandry. He succeeds **D. J. Kays**, who is retiring as chairman to the position of professor in the department. Professor Sutton will continue as assistant dean. Succeeding him in the chairmanship of agricultural biochemistry will be **Fred Deatherage**. Professor Sutton will also serve as chairman of the Department of Animal Science at the Ohio Agricultural Experiment Station at Wooster, succeeding **R. M. Bethke**, who has resigned.

**Ralph E. Thiers** has been made an assistant professor of chemistry in the Pratt Trace Analysis Laboratory, School of Chemistry, University of Virginia. **J. J. Kirkland**, **Fritz Will III**, and **J. F. Williams** have been awarded predoctoral fellowships in the laboratory.

Twenty-five of the nation's leading scholars, including four Nobel prize winners, received honorary degrees at Yale University's 250th commencement. One of the most significant awards went to **Edward Chace Tolman**, who was among a group of faculty members dismissed last year by the University of California for refusing to sign a loyalty oath. Dr. Tolman, a past president of the American Psychological Association, is now a visiting professor at the University of Chicago. Accused by the California State Legislative Committee on Un-American Activities of membership in at least six so-called subversive groups, Dr. Tolman was honored with a doctor of science degree not only for his professional work but also as a "valiant defender of the freedom of the mind." Among other honorary degree recipients were **John Dewey**, **Harold C. Urey**, **C. H. Mathewson**, **Elmer D.**

**Merrill**, **A. H. Sturtevant**, **Norman L. Bowen**, **Otto Loewi**, **Percy W. Bridgman**, **Theodore von Karman**, **Gerty T. Cori**, **Henry N. Russell**, and **Peter H. Buck**.

**Francis J. Turner**, professor of geology on the Berkeley campus of the University of California, has been named recipient of the Hector Memorial Medal and prize for 1951 by the Royal Society of New Zealand. The award, conferred on a geologist once every six years, is given to the investigator working within the Dominion of New Zealand who has "done most towards the advancement of that branch of science to which the medal and prize are in such year allotted." The award was made for Professor Turner's research in metamorphic petrology and on problems of recrystallization of rocks at high temperatures and pressures.

**Byron H. Webb** has been appointed senior scientist with the National Dairy Research Laboratories, Oakdale, L. I., and will act as a scientific adviser on the staff of **Arnold H. Johnson**, vice president and director of research. Dr. Webb is currently principal dairy technologist in the U. S. Bureau of Dairy Industry, which he joined in 1926. **Edwin G. Stimpson** has been appointed assistant director for biochemistry, Division of Nutrition and Biochemistry. He first joined the laboratories at Baltimore in 1930, returning there in 1938 upon completing his graduate work.

## Education

**James A. Ford**, of the American Museum of Natural History, in collaboration with **Philip Phillips**, of Harvard's Peabody Museum, and **James A. Griffin**, of the University of Michigan, has found evidence at the Jaketown Site, near Belzoni, Humphries Co., Miss., of preceramic human occupation. Extensive investigations of the lower Mississippi Valley, begun by Dr. Griffin, have been carried out since 1941.

The first technicians to arrive in Canada under the Technical Co-operation Programme of the Colombo Plan for Economic Development in South and South-East Asia were: **K. A. Rehman**, director of agriculture, Punjab; **A. M. Sial**, of the Ministry of Agriculture and Education of the State of Khaipur; and **S. Hidayatullah**, director of agriculture for East Bengal. Indian members of the agricultural mission have also arrived. Two other missions, one concerned with road construction and bridge erection, the other with hydroelectric development, are expected in Canada late this summer from India, Pakistan, and Ceylon. First of the some 60 scholars and fellows due in Canada to take advantage of the government's offer of instruction in Canadian government departments, universities, and industry have also arrived. They will study such subjects as railway operation, medical science, the national insurance program, farm and soil mechanics, marketing methods, geology, factory management, land settlement, and town planning.

The Columbia College Council, composed of 20 edu-

cators, business, and professional men, will make a firsthand study of the college program and act as permanent advisers on all questions affecting the institution's development. Frank D. Fackenthal, consultant to the Carnegie Corporation of New York, will head the council. Harry J. Carman, Hugh J. Kelly, and Nicholas McD. McKnight are among other members of the council.

The **Free Russia Fund**, established in May by the Ford Foundation (*Science*, 113, 666 [1951]), has formed the Research Program on the USSR, to provide a research center on the Soviet system, where a small group of recent Russian exiles can cooperate with American specialists in political, administrative, and economic fields. In addition, the program will also use the services of other, selected Soviet exiles in American universities and research institutes. Philip E. Mosely, director of the Russian Institute at Columbia, will be director of the new organization, and Alexander Dallin, associate director. Temporary offices are at 425 W. 117th St., New York.

As a part of a program to raise living standards in underdeveloped areas, **Unesco** has approved 12 projects in education and 11 in scientific research. Ellsworth Obourn, Clayton, Mo., science teacher, has arrived in Thailand to set up curriculum-workshop-laboratories for Thai science teachers. Joseph Jablow, anthropologist, of Brooklyn College, is in Liberia to aid in building up the country's educational system. Unesco has also sent the following to form the nucleus of a science faculty at Liberia College: Mogens Pihl, of Denmark (mathematics); P. J. G. Huijter, of the Netherlands (physics); Arthur J. D. Barker, of New Zealand (biology); and Henry C. McBay, of Morehouse College, Atlanta (chemistry). Leader of a four-man mission to Pakistan is Gunnar Norgaard, Danish geophysicist. Others expected to join him are Michael Fournier d'Albe, French physicist; Henry I. S. Thirlaway, a British seismologist now working in Australia; and Karl Wienert, German expert on terrestrial magnetism. Fritz Karsen, on leave from his post as associate professor of education at Brooklyn College, has arrived in Quito as director of a mission to Ecuador. Another member of the mission is Roger Ouvrard, French electrical engineer. At the request of the Philippine government, Unesco has sent Luis Medellin Nino, federal director of education in the Mexican state of Aguascalientes, to Manila to aid in raising the economic and social level of community life.

Under the supervision of Stuart C. Dodd, and with the cooperation of Louis L. Thurstone, the **University of Washington-U. S. Air Force "Project Revere"** will attempt to develop, by various methods, fundamental principles affecting the spread of messages through person-to-person communication. The effect on populations of leaflets dropped from airplanes will be an important phase of the study.

The **Woman's Medical College of Pennsylvania** has named Burgess Lee Gordon, of Philadelphia, as its first full-time president. Dr. Gordon was formerly

clinical professor of medicine at Jefferson Medical College and a director of the Department for Diseases of the Chest. He will take up his new post on Sept. 1.

## Grants and Fellowships

The **American Heart Association** is accepting new research applications in cardiovascular and related fields for the academic year 1952. Applications for the two categories of awards, Research Fellowships and Established Investigatorships, may be submitted up to *September 15*. The latter may be granted for five years at a minimum stipend of \$5,000, with annual increases; the former are for one year, with stipends ranging from \$3,000 to \$4,300. Applications for Research Grants-in-Aid to institutions, which vary in amount, may be filed up to *December 1*. Apply to Medical Director, AHA, 1775 Broadway, New York 19.

**Isadore Leviton**, president of Leviton Manufacturing Co., Brooklyn, has given five subsidiary scholarships to the Chicago Medical School for the five-year period 1950-54.

**Donald D. Van Slyke** has become counselor to the **Lilly Research Grants**, sponsored by Eli Lilly and Company. Dr. Van Slyke served as research chemist at the Rockefeller Institute for Medical Research from 1907 to 1948, when he became an emeritus member of the Institute.

The **University of Michigan School of Graduate Studies** has awarded fellowships to 16 faculty members for various research projects. A. Benjamin Handler will make a critical review of U. S. housing needs; George Piranian and Leonard Tornheim will study problems and proofs in higher mathematics; Frederick P. Thieme will prepare a statistical analysis of a previous study of the physical characteristics of the Puerto Rican population; and Paul A. Wright will study the function of the hormone related to darkening pigment in marine and land animals.

The **New York Foundation** has made a grant to the Hospital Council of Greater New York for a special study of the types of patients cared for in the municipal hospitals, looking toward more efficient utilization of New York hospital facilities.

Under the direction of William A. Hunt, Northwestern University will begin Sept. 1, for the **Office of Naval Research**, a study and development of materials and techniques to aid in the neuropsychiatric selection of Navy personnel. Cecil L. Wittson, professor of neurology and psychiatry at the Medical College of the University of Nebraska, will be associated with Dr. Hunt.

The **Wisconsin Alumni Research Foundation** has authorized a total of \$506,000 to be used for approximately 220 grants-in-aid for 1951-52 research at the University of Wisconsin. In addition, \$193,368 has been allocated to various other university projects.

## Meetings and Elections

Charles J. Nocar, of the E. F. Hauserman Company, Cleveland, has been re-elected president of the **Acoustical Materials Association**, and George W. Handy, of the National Gypsum Company, re-elected vice president. Fourteen members of the association were elected to the Board of Directors. Both officers and directors serve a one-year term.

**American Society of Limnology and Oceanography** held its annual meeting on the campus of the University of Southern California in conjunction with the meetings of the Pacific Division of the AAAS in June. Martin W. Johnson, of the Scripps Institution, was elected president; J. L. Hart, vice president; John P. Tully, secretary-treasurer; and Paul R. Needham and Norris W. Rakestraw, members-at-large.

A conference on **The Chemistry and Physiology of the Nucleus** will be held at Brookhaven National Laboratory Aug. 15-17. Sponsored by the Biology Department, it will feature 18 speakers and five demonstrations, each speech to be followed by a discussion period. The invited papers will be published after the conference. For further information and reservations address the Biology Department, Brookhaven National Laboratory, Upton, L. I., New York.

Six Nobel prize winners were among the more than 100 physicists that met with Niels Bohr in a five-day **Conference on Atomic Science** in Copenhagen. Cecil F. Powell, P. M. S. Blackett, P. A. Dirac, George de Hevesy, Wolfgang Pauli, Werner Heisenberg, and John Cockcroft were among those participating in the discussions. Thomas and Charles Lauritsen, of Caltech, also attended.

The thirteen members of the **Interdepartmental Committee on Pest Control**, representing the Departments of Defense, Agriculture, Federal Security, and Interior, met at the National Institutes of Health and elected H. L. Haller chairman and S. W. Simmons secretary. The committee seeks to coordinate the work and exchange of information among governmental agencies and to promote a better understanding of pest control in both industry and government. The next meeting will be held Sept. 21.

Cornell's School of Electrical Engineering will be host at the meeting of the **USA National Committee of the International Scientific Radio Union** and the **Institute of Radio Engineers Professional Group on Antennas and Propagation** to be held October 8-10. Papers are invited, and advanced registration is advised. Further information may be obtained from A. H. Waynick, Pennsylvania State College.

## Recent Deaths

Byron Alder, poultry expert, Logan, Utah, Apr. 7; Brooke M. Anspach (75), gynecologist, Ardmore, Pa., July 9; Percy Bartlett (80), surgeon, Hanover, N. H., July 6; Antonin Besse, industrialist, Elgin, Scotland,

July 3; Omar J. Brown (48), authority on tropical medicine, Washington, D. C., July 7; John T. Buchholz (62), botanist, Champaign, Ill., July 1; Verne G. Burden (56), surgeon, Philadelphia, June 23; Cornelius Vander Clock (73), surgeon, Passaic, N. J., July 9; Ben Cohen (57), obstetrician and gynecologist, Toronto, July 4; Charles M. Cooper (77), physician, San Francisco, July 9; Josephine De Karman (57), expert on international scientific relations, Los Angeles, July 2; Ernest M. Doblin (47), economist, Jamaica, N. Y., July 15.

Hyman J. Epstein (70), gynecologist, New York, July 1; Rafael B. Espino (60), agricultural botanist, Laguna, Philippines, May 18; John M. Fallon (49), surgeon, Shrewsbury, Mass., June 21; Thomas Fudge (75), chemist, Elizabeth, N. J., July 10; William M. Gibson (47), political scientist, Sumner, Md., July 6; Curvin H. Gingrich (70), mathematician and astronomer, Northfield, Minn., June 17; Joseph S. Goldwag (64), inorganic chemist, New York, July 11; Leonard G. Grimmer (48), physicist, Houston, Tex., May 27; Clarence M. Haring (73), veterinarian, Oakland, Calif., July 10; László J. Havas (66), pathologist, Colmar, Alsace, June 9; Ruth Heck (57), pediatrician, Rochester, Minn., June 18; Ludwig Hektoen (88), pathologist, Chicago, July 5; Edwin W. Holladay (68), clinical professor of obstetrics and gynecology, Charlottesville, Va., June 20; Gilbert L. Houser (85), neurologist, Iowa City, July 16.

Dugald C. Jackson (86), electrical engineer, Cambridge, Mass., July 1; Charles F. Jenkins (85), historian, horticulturist, and publisher, Philadelphia, July 2; Frederic B. Johnson (75), of Yale University, New Haven, June 27; Clifford B. Lull (57), gynecologist, Philadelphia, July 6; Roswell C. McCrea (74), educator, Newton, N. J., July 2; Duncan McDuffie, conservationist and civic leader, Berkeley, Calif., Apr. 21; Edgar P. McNamee (61), roentgenologist, Cleveland, July 8; Harry P. Mera (75), archaeologist, Santa Fe, N. M., Apr. 15; Edward L. Moreland (65), electrical engineer and retired vice president, MIT, West Falmouth, Mass., June 17; Richmond C. Nyman (51), of Yale University, Hamden, Conn., June 27; Abraham Ossip (61), radiologist and roentgenologist, New York, July 3; Charles D. Perrine (83), astronomer, Villa General Mitre, Argentina, June 21; Alfred C. Reed (66), authority on tropical medicine, Mill Valley, Calif., June 20; Frank E. Richart (59), engineer, Urbana, Ill., July 16.

For 28 years the AAAS has been able to award its \$1,000 Prize at each annual meeting through the generosity of an anonymous donor. On July 29 death removed the cloak of anonymity, which Newcomb Cleveland modestly insisted should be preserved as long as he lived. Mr. Cleveland was long active in the Erickson Co., an advertising firm, and his interest in science was a hobby. His prize was inspired by the conviction that it is the scientist who counts, and who needs the encouragement an unexpected monetary award can give.



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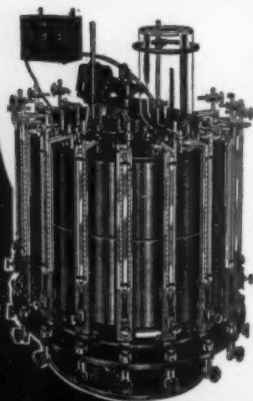
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## Publications Received

- Nitrogen in the Life of Plants.* Dmitrii N. Prianishnikov. Mimeo. Kramer Business Service, Madison, Wis. 1951. \$2.75.
- Multiple Sclerosis: Application of Rehabilitation Techniques.* Edward E. Gordon. National Multiple Sclerosis Society, New York. 1951.
- Materiales para el Estudio de la Clase Media en la América Latina. V. La Clase Media en Costa Rica, Haití y Venezuela.* Theo R. Crevenna, Ed. Union Panamericana, Washington, D. C. 1951. 30 centavos.
- An Emergency Tax Program for 1951.* Mar. 1951. *Economic Aspects of North Atlantic Security.* May 1951. Committee for Economic Development, New York.
- Correction Tables for Radioactive Decay.* Barbara S. Smith. Laboratory of Physical Biology, National Institute of Arthritis and Metabolic Diseases, USPHS, Bethesda, Md. Apr. 1951.
- The Schuman Plan Constituting the European Coal and Steel Community.* State Department Pub. 4173. GPO, Washington, D. C. Apr. 1951. 55 cents.
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- Die Botanische Buchillustration.* Bd. I, *Geschichte.* Bd. II, *Bibliographie.* Claus Nissen. Hiersemann Verlag, Stuttgart, Germany. 1950.

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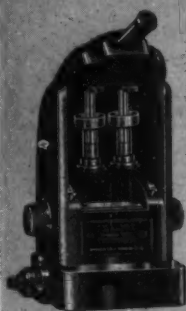
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- Aug. 20-23. National Council of Teachers of Mathematics (Annual). St. Olaf College, Northfield, Minn.
- Aug. 26-30. Poultry Science Association. Knoxville, Tenn.
- Aug. 26-31. American Pharmaceutical Association. Statler Hotel, Buffalo.
- Aug. 27-30. Illuminating Engineering Society. Washington, D. C.
- Aug. 27-31. American Society of Agronomy. Pennsylvania State College, State College.
- Aug. 27-31. Soil Science Society of America. Pennsylvania State College, State College.
- Aug. 31-Sept. 5. American Psychological Association. Hotel Sherman, Chicago.
- Sept. 1-3. Astronomical League. University of North Carolina, Chapel Hill.
- Sept. 3-4. Mathematical Association of America (Summer). University of Minnesota, Minneapolis.
- Sept. 3-4. Symposium on Optical Investigation of the Earth's Atmosphere. Liège.
- Sept. 3-7. American Chemical Society (Annual). New York.
- Sept. 4-7. American Mathematical Society (Summer). University of Minnesota, Minneapolis.
- Sept. 4-8. Second Alaskan Science Conference. Alaska Division, AAAS, and University of Alaska. Mt. McKinley National Park.
- Sept. 4-9. British and Austrian Iron and Steel Institutes (joint meeting). Salzburg.
- Sept. 5-7. Mycological Society of America. University of Minnesota, Minneapolis.
- Sept. 5-8. Dutch Society for Psychotherapeutics. Leiden.
- Sept. 8-9. International Union of Pure and Applied Chemistry. New York.
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- Sept. 12-14. American Water Works Association, Minnesota Section. Hotel Nicolet, Minneapolis.
- Sept. 12-14. Biological Photographic Association (Annual). Kenmore Hotel, Boston.
- Sept. 12-14. National Petroleum Association. Hotel Traymore, Atlantic City.
- Sept. 13. World Metallurgical Congress. Detroit, Mich.
- Sept. 13-15. American Institute of Mining and Metallurgical Engineers, Nonmetallurgy Division. West Virginia University, Morgantown.
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